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EDITED BY
LEWIS STEPHEN PILCHER, M.D., LL.D.,
OF NEW YORK

WITH THE ASSOCIATION OF
JAMES TAFT PILCHER, B.A., M.D.,
AND THE COLLABORATION OF

SIR WILLIAM MACEWEN, M.D., LL.D.,
OF GLASGOW,
Professor of Surgery in the University
of Glasgow.

W. H. CLAYTON GREENE, F.R.C.S.
OF LONDON.

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FATAL ANAPHYLAXIS FOLLOWING BLOOD TRANSFUSION*

BY GEORGE LUNSFORD CARRINGTON, M.D.

AND

WALTER ESTELL LEE, M.D.

OF PHILADELPHIA, PA.

Blood transfusion in recent years has assumed such a position among the therapeutic measures of the medical profession and at the present time is being so widely employed in the treatment of such a variety of conditions, that any light thrown upon its effects—good or bad—may be regarded as worth while.

The reactions following transfusion have been of varied type and the reports of their frequency have shown as much variation. Whether reactions are more frequent and more severe after the use of the citrate method than they are after other methods of whole blood transfusions is still under discussion. Certain it is that reactions have occurred after all methods that are in general use at the present time. These reactions have varied from a passing feeling of chilliness, through headache, malaise, fever, chills, urticaria, hæmolysis with hæmoglobinuria, acute anaphylactic shock, acute anuria, delirium, to death.

Ravidin and Glenn report one hundred thirty-eight citrate transfusions and forty-seven Kimpton tube transfusions with the same percentage of chills. They had one death by each method. Sloan reports four hundred thirty-six Kimpton tube transfusions at the Lakeside Hospital with temperature reactions of one degree Centigrade in five per cent. of the cases. Kimpton has had five hundred transfusions since 1912-13 with two deaths. Bernheim has had two deaths following transfusion with matched blood by the citrate method, and one death following transfusion by the same method when unmatched blood was used. He says that he knows of four unreported deaths that followed transfusions done by the citrate method. He is authority for the statement that reactions follow 20 to 40 per cent. of transfusions done by the citrate method but that they follow only about 5 per cent. of those performed by the ordinary methods of whole blood transfusion.

Explanations of the reactions following transfusions are unsatisfactory. No one can even consistently predict when there will be a reaction and when there will be none. From the accumulating evidence, however, there are some suggestions that are worth noting.

* Read before the Philadelphia Academy of Surgery, January 8, 1923.

I. Too rapid introduction of the blood may embarrass the circulation.

II. Ramirez has reported a case of horse asthma following blood transfusion. A donor, who was sensitive to horse dandruff, gave six hundred cubic centimetres of blood. The recipient, who had not previously been sensitive, developed a typical acute asthmatic attack upon exposure to horses two weeks after the transfusion. He had a similar attack one day later. Another patient transfused from the same donor, however, failed to show similar phenomena.

III. Some have thought that the cause of reaction is to be found in hypothetical changes that take place in the protein of the blood upon exposure to air.

IV. Burman of the Mayo Clinic has called attention to the rôle that new rubber tubing made by one industrial concern may play in the reaction. This reaction can be guarded against by soaking the new tubing six hours in normal sodium hydroxide solution.

V. Incompatibility between the blood of the donor and that of the recipient was a frequent cause of severe reaction before the days of blood grouping. Even when the tests have been made it may still happen that through the inexperience of the operator or the staleness of the sera used in making the tests, an incompatible group may appear to be compatible. The symptoms following a fatal transfusion with incompatible blood may be described in the words of Peterson: "The clinical picture of these reactions is typical. They occur early, after the introduction of fifty or one hundred cubic centimetres of the blood; the patient first complains of tingling pains shooting over the body, a fullness in the head, an oppressive feeling about the precordium, and, later, excruciating pain localized in the lumbar region. Slowly but perceptibly the face becomes suffused a dark red to a cyanotic hue; respirations become somewhat labored, and the pulse rate, at first slow, sometimes suddenly drops as many as twenty to thirty beats a minute. The patient may lose consciousness a few minutes. In one-half of our cases an urticarial eruption, generalized over the body, or limited to the face, appeared with these symptoms. Later the pulse may become very rapid or thready; the skin becomes cold and clammy, and the patient's condition is indeed grave. In from fifteen minutes to an hour a chill occurs, followed by a high fever, a temperature of 103 to 105, and the patient may become delirious. Jaundice may occur later. The macroscopic appearance of hæmoglobinuria is almost constant."

In another case reported (Bernheim), the functions of the kidneys became so interfered with by deposits of hæmoglobin or red blood-cells that the patient died with suppression of urine and all the signs of uræmia.

Reactions in this group of cases vary at least partly according as: (1) The donor's corpuscles are hæmolyzed by the recipient's serum; (2) The recipient's corpuscles are hæmolyzed by the donor's serum; (3) The corpuscles of each are hæmolyzed by the serum of the other. Hæmolysis is stated

to be preceded always by agglutination, however, and it seems that agglutination may be the more rapidly fatal of the two.

VI. Serious reactions sometimes occur after repeated transfusions in patients suffering with primary anæmia. Bowcock has reported several such cases. In one case the reaction occurred after 175 cc. of citrated blood had been introduced (this was the fifteenth transfusion for the patient). Respirations became sighing and the patient was slightly dyspnoeic, shaking but not chilly. Temperature 104.6. Vomited. The patient became irrational and remained so for more than a week. During that time urinary and fecal incontinence alternated with urinary retention. The urine was orange colored and contained red blood-cells and hæmoglobin.

This reaction is rather suggestive, as we have seen, of the type of reaction following transfusion with blood of an improper type. Some weight is lent to this view by the fact that when the blood of the donor and recipient were rematched for the second time the donor's serum against the recipient's cells gave a very slight hemolysis. In this connection it may be of interest to note that McClure and Dunn have shown that a donor may be compatible for one transfusion but be incompatible for a subsequent one, and this can be demonstrated by blood matching.

VII. The citrate method has an equal part with the other methods in the ills described above, and in addition has its own individual troubles. Lewisohn, however, after a long series of parallel cases thinks the results from the citrate method are as good as any. Drinker thinks that there are a few, and only a few more reactions after the citrate method. Lewisohn has shown that five grams of sodium citrate in solution can be given man intravenously without a toxic reaction. We are not informed, however, as to whether any of this work was done on patients suffering with a blood dyscrasia. Keynes, while using the citrate method, states that he has seen one reaction from citrate solution given intravenously in small amount. Speaking of the reaction following the injection of citrated blood he says: "The symptoms of this reaction are a slight headache, a rise in temperature to two or three degrees above the normal, sometimes accompanied by a rigor or sensation of chill, and an increase in the pulse rate. The effect is, however, always very transitory, lasting only two or three hours, and is never, in my own experience, attended by any symptoms that need give rise to anxiety for the patient's welfare; nor does it in any way prejudice the therapeutic results of the transfusion." The belief in many quarters of the United States is certainly at variance with the above view as applied to markedly anæmic patients suffering with one of the blood dyscrasias.

Drinker and Brittingham think that the reactions following transfusions with citrated blood are due to: (1) Incompatibilities not detected in vitro. (2) Platelet changes in the process of coagulation. (3) The action of the citrate solution on the red cells increasing their fragility and promoting hæmolysis.

CASE REPORT

Mr. J. C., age seventy-five, white. Referred by Doctor Cloud to Dr. W. E. Lee for transfusion. Admitted to Bryn Mawr Hospital, July 24, 1922. Complaint: Weakness. Tires easily. Family History: Not pertinent to the present illness. Past History: Patient has had measles, mumps, chicken-pox, scarlet fever, diphtheria, whooping cough. He has an occasional sore throat. He had a Neisserian infection as a young man. Jaundiced once twenty-five years ago. Hemorrhoidectomy many years ago. Uses alcohol and tobacco moderately. Present Illness: Six weeks before admission, patient noticed that he tired more easily than formerly. He felt that he was distinctly weaker. He became conscious about that time of his heart palpitating. Appetite remains good. He sleeps well. His bowels move regularly. He has lost twenty-five pounds during the last three months. Review of systems is essentially negative.

Physical Examination.—The patient is a slightly undernourished white male of about seventy-five years. He does not appear to be in any pain or distress. The skin is pale and rather lemon yellow in color. The mucous membranes are pale. There is no local or general glandular enlargement of note. Arteries are in good condition. Pulse is regular and of fair volume. Blood pressure 130/65. The lungs are clear to percussion and auscultation. Heart not enlarged, sounds well heard. There is a slight blowing systolic murmur at the apex. This is not transmitted. It is probably an hæmic murmur. Abdomen, extremities, and reflexes are negative. Laboratory: Wassermann negative. Urine negative. Phenolsulphonaphthalein test, 50 per cent. in two hours. Blood examination on three different occasions showed practically the same findings: Red blood-cells, 1,400,000, hæmoglobin, 28 per cent., white blood-cells, 4,600. Remarks: Red cells of good color. Considerable anisocytosis and poikilocytosis. No nucleated red cells. Blood type: III (Moss).

The patient was transfused August 17, 1922, at 5:00 P.M. He was given 500 c.c. of blood in 55 c.c. of 2 per cent. sodium citrate solution. The citrate solution was made just before the operation with water that had been distilled that day. The donor was a man who appeared to be in good health, had a negative Wassermann, belonged to Type III of the blood groups, and had had his blood matched that day against the recipient's without any evidence of agglutination or hæmolysis. The transfusion was performed slowly through tubing previously used for intravenous therapy. During its performance the patient showed no evidence of distress, but on the contrary appeared to be in quite good condition. He continued to appear normal for about one hour, when he developed great respiratory difficulty. His breathing was distinctly asthmatic in type. He gasped for breath and there was a laryngeal stridor. Innumerable piping musical and a few moist râles could be heard throughout both sides of his chest. There was no increase in the area of cardiac dullness. Heart sounds were not noticeably affected. The patient was slightly cyanosed. He voided in the bed and had a bowel movement during the paroxysm. He was conscious. There was no paralysis. Brandy, adrenalin, atropine, benzyl-benzoate, and morphia were given. At ten o'clock he appeared better, but at midnight he had a rattling in the throat, moist râles throughout both lungs, and the symptoms of a pulmonary edema. He became comatose a little later and died at three o'clock the next morning, ten hours after the performance of the transfusion. A specimen of venous blood taken a short time before death showed no clumping or hæmolysis of the red cells. The urine was clear and examinations for red blood-cells and hæmoglobin were negative.

In this case, we find a man with a primary anaemia developing the symptoms of acute anaphylactic shock following a first transfusion. The onset was with spasm of the smooth muscle in bronchioles, bladder and bowels; evidenced by respiratory difficulty, typical asthmatic râles, urinary and fecal incontinence. The spasm of smooth muscle was followed by a relaxation with which was associated a pulmonary oedema. The temperature rose to 102 and then returned to normal. Pulse and respirations rose and remained elevated, being around 130 and 36 respectively. The patient had a primary anaemia. So far as any evidence that we have goes the primary anaemia was at that time aplastic.

The selection of the citrate method in such a type of case will meet with serious questioning in many quarters. The giving of an initial transfusion of five hundred cubic centimetres will also be questioned. Neither of these, however, are sufficient to account for a lethal exodus. The blood of the donor was carefully typed and cross-agglutinated with that of the recipient. After the reaction had progressed for several hours the venous blood showed no evidence of agglutination or haemolysis. The urine showed no evidence of hemolysis. There was nothing to indicate an infarction in any locality. There was no history of asthma, hay fever or other type of protein sensitization in either the donor or the recipient. True anaphylaxis requires that there shall have been a preceding sensitization with a minimal dose of a similar foreign protein introduced into the circulation. Of such there scarcely seems a possibility here, yet the reaction following the transfusion—a reaction delayed for one hour—when it did develop was typically that of an acute anaphylaxis.

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PLEURAL EPILEPSY*

By HUBLEY R. OWEN, M.D.

AND

A. GONZALEZ, M.D.

OF PHILADELPHIA, PA.

FROM the earlier days of medical history when the clinical observations of a few brilliant minds were the only reliable bases of medical knowledge, to the present time with our well equipped laboratories managed by competent men, and with our post-mortem amphitheatres where death has given the solution to many of the enigmas of life, the problem of epilepsy remains practically unanswered. Medical literature contains many excellent articles on this subject. The disease has been carefully and systematically studied. Many divisions have been made grouping the cases according to their etiology or symptomatology. A number of cases were so placed under the name of "Reflex Epilepsies." In this connection the name of Brown-Sequard should be mentioned.¹ Even now his masterful work is consulted as avidly as it was many years ago. As a result of his studies the name of "Reflex Epilepsy" came into medical parlance, a very fortunate and logical term endeavoring to explain the etiology of the disease.

We are here concerned with the sub-group that Aubouin,³ in 1878, first called "Pleural Epilepsy" (*Epilepsie Pleuretique*), an epileptiform manifestation occurring when the pleural membranes are stimulated by either physical or chemical agents.

Having observed such a case during the injection of Beck's paste (30 per cent. of bismuth subnitrate in vaseline) into a chronic empyema cavity preparatory to röntgenographic studies, we decided to review the literature on this subject in search of some plausible explanation of this curious phenomenon.

HISTORICAL

The first recorded case of convulsions complicating the treatment of empyema was reported in 1864 by Roger,² who presented to the Medical Society of Parisian Hospitals the case of a young girl, eight years of age, who had bronchopneumonia followed by empyema. Roger treated the empyema by thoracentesis and pleural lavage. Numerous injections of antiseptic solutions were used. During one of these injections the girl suddenly collapsed and soon after had an epileptiform seizure. The patient remained semi-conscious for several hours, but completely recovered. Roger believed that the convulsive seizure was due to the injection of a large quantity of fluid rapidly, compressing the lung. It was not Roger's object to discuss pleural epilepsy. He only mentioned its occurrence as a passing remark on the case.

* Read before the Philadelphia Academy of Surgery, January 8, 1923.

PLEURAL EPILEPSY

A few years later (1875), Maurice Raynaud made an especial communication on the disease to the Society of Parisian Hospitals, reporting two personal observations of pleural epilepsy. The Paris clinicians evidently were awakened to its importance, for in the same year similar cases were reported by Lepine, Wallain and Brouardel.

In 1878, Aubouin, in presenting his graduating thesis to the University of Paris, reviewed the literature on the disease and for the first time called it: "Pleural Epilepsy."³ Since then over fifty cases have been reported. The large majority of reported cases are to be found in the French Literature. Goodhard and Thompson, in England, and Von Dusch, in Germany, were early contributors. In this country no great attention has been paid to pleural epilepsy, for we have been able to find only the briefest literature on the subject.

DaCosta⁴ mentions that syncope or convulsions may occur during paracentesis thoracis.

In 1892, Jeanselme published a very complete work on "The Nervous Accidents of Thoracentesis and Empyema." In this work he analyzes the facts concerning pleural epilepsy, and reports six cases observed by deCrenville, one by Letulle, and one by Hutinel. Other papers were written by Cestan, Camus, Roch and Cordier.

ETIOLOGY AND PATHOLOGY

When many causes are attributed to a disease, as in cancer, and not many years ago in syphilis, no one of these causes is usually satisfactory. One observer may lay great stress on one symptom, while the same symptom is of but little importance to another observer. The value of interpretation of a group of facts is a matter of personal equation, which may vary greatly. In "Pleural Epilepsy" many etiological factors have been brought into the foreground. Race and age have no bearing on the disease. Men are more frequently affected than women. This may be due to the fact that men suffer from empyema more frequently than women.

The exciting cause is the introduction into thoracic cavity of some foreign substance: Beck's paste, or an antiseptic solution, such as, carbolated water or Dakin's solution. In some cases reported the introduction of an aspirating needle caused an attack. In the majority of the cases the convulsion occurred during the therapeutic procedure. In a small number of cases the convulsions occurred after several hours or even days.

The necropsy studies of fifteen cases of pleural epilepsy throw no light on the subject. There were a few minor pathological changes which could not account for the disease.⁵

Endeavoring to explain the cause of this obscure condition, several theories have been advanced: (1) Toxic, (2) Mechanical, (3) Uremic, (4) Anaphylactic, (5) Embolic and (6) Reflex. Only the last three deserve a word of explanation.

Anaphylaxis is the latest theory as the etiological factor of pleural epilepsy. This theory, which originated at the time when many diseases were attributed to anaphylaxis, might prove useful in some cases, but we cannot conceive that the injection of bismuth paste or of sterile water could cause anaphylaxis. Bismuth has been used in many other conditions, such as tubercular sinuses, with no anaphylactic reaction. The injection of water as a cause of anaphylaxis seems out of the question; moreover, anaphylactic reaction cannot be explained by the introduction of an aspirating needle. It is difficult to properly explain those few cases in which the convulsion occurred several hours after the injection of an antiseptic fluid.

The embolic theory aims to interpret the convulsions with the supposition that small fragments of foreign matter are carried by the blood stream to the motor areas of the brain. These particles acting as emboli produce cerebral irritation and probably a small area of anemia. The system responds to the irritation by convulsions which may be either local or general. If the irritation is too great or the embolus too large paralysis ensues. In pleural epilepsy paralysis, if present, is transient. In only one case reported was the sign of Babinski demonstrated. The embolic theory was advanced by Von Dusch, who had a single case which at necropsy showed thrombosis of the pulmonary arteries, small hemorrhages in the cerebral cortex and anemia of the brain. It is interesting to note that cerebral anemia is mentioned in the post-mortem reports of two cases,⁶ and also in Osler's System of Medicine.⁷ While not supporting the view of Von Dusch, it is worthy of mention that in primary endothelioma of the pleura and in cases of carcinoma of the breast, which infiltrate the pleura, metastasis to the brain is not uncommon.

At present we have a case of endothelioma of pleura, with metastasis to the brain, under treatment. These metastases are easy to understand when we remember that the pulmonic veins carry the blood from the alveoli of the lungs directly to the left auricle and from there to the left ventricle and general arterial system. We could imagine minute particles of foreign matter placed in the intervalveolar spaces carried to the brain by the blood. These minute particles may not be large enough to cause a paralysis, but sufficiently large to irritate and cause a convulsion. Embolic phenomena probably occur in parts other than the brain but such parts may not be sufficiently sensitive to cause any disturbance. It is not believed the entrance of air emboli or the injection of a liquid whose specific gravity is different from that of blood could cause such phenomena. Such liquids may, however, serve as a vehicle for the solid particles or emboli. Without denying the possibility of embolism occurring in a few cases, we cannot explain the entrance of emboli into the systemic circulation without penetration of the lung tissue by the foreign substance.

The reflex theory is the one commonly accepted. This theory is based upon the belief that the convulsive seizure is the response of the higher motor centres when the pleural terminations of the peripheral nerves are stimulated by a physical or chemical agent. Experimental work by Gilbert and Roger in

1892, Roch in 1905, Thiroloix and Bretonville in 1910, Cordier in the same year, and in this country by Capps and Lewis, supports this theory. Laborde in 1892 was unable to produce convulsions by electrical stimulation of the intercostal nerves. Roger and Gilbert, working on dogs, produced convulsions in two cases, one by the injection of tincture of iodine into the pleural cavity and the other by the injection of metallic mercury. The injection of air into the pleural cavity caused no convulsion. The same authors also state: "The injection of 1 c.c. of 1 per cent. solution of stovain into the pleural cavity prevented the convulsions, but not the asphyxia that could come from the injection of a large quantity of air. This proves that these phenomena are reflex in origin."

Some of the most important conclusions of Cordier⁹ are as follows:—1. The pleural membranes tolerate the injection of air under pressure. 2. The injection of tincture of iodine causes a convulsive attack. 3. Cocaine and stovain, although very toxic to animals, prevent the convulsions. 4. Ligation of the carotids has no bearing on the final results. 5. Resection of the pneumogastries prevents the convulsions, while resection of the sympathetic does not alter the results. 6. The administration of anæsthetics averts the convulsions. In all these experiments animals with intact pleuræ were used. Later Cordier repeated these experiments on animals whose pleural cavities had been injected with Friedlander's bacillus. The results were practically the same. Capps and Lewis¹⁰ were interested in a closely related subject. They studied the reflex blood pressure changes and referred pain produced by pleural irritation. They concluded that pleural irritation may produce a dangerous or even fatal fall in the blood pressure. In their work on reflex pain of pleural origin they irritated the pleuræ of thirty-five empyema patients, but there is no mention of any convulsive seizure during or subsequent to such irritation.¹¹

Analyzing these results it is evident that the reflex theory offers the best and most logical explanation of this confusing phenomenon. It is the only theory that has been supported by experimental work.

SYMPTOMATOLOGY

As we have only five cases to report we are forced to study the forty-nine cases that have appeared in the literature for information as to symptomatology. There are no pathognomonic symptoms of pleural epilepsy. The convulsion is identical with that of idiopathic epilepsy.

The prodromal period in pleural epilepsy is often manifested by an attack of syncope. In a few cases the patients had time to complain of pain or discomfort. The period between the prodrome or aura, and the convulsion, is of short duration, never more than a few minutes. The patient is then thrown into an epileptiform convulsion, which, as said before, does not differ from that of idiopathic epilepsy. Some cases terminate by sudden death, without motor symptoms. Such death may be due to reflex cardiorespiratory inhibition, for which we suggest the name of "pleural shock."¹² The Jacksonian

type of convulsion was noted in one case. In two other cases of generalized convulsions one side was more markedly affected than the other. No explanation is given. Transitory hæmiplegia occurred in nine cases. The side of the hæmiplegia did not necessarily correspond to the side of the empyema. Involvement of one of the upper extremities alone was mentioned in six cases. There was only one case in which the hæmiplegia lasted as long as several hours.

The pulse was rapid and some irregularities and other signs of cardiac embarrassment were noted. The respirations were labored and occasionally of the Cheyne-Stokes' type. In many cases it was necessary to employ artificial respiration.

The temperature did not seem to be affected. It is interesting to note that cough was a rare symptom, and was mentioned in only two cases of the series.

There was nothing characteristic in the cerebrospinal signs. There was often inequality in the pupils with extreme myosis or midriasis. In five cases there was conjugate deviation of the eyes to the right. Convergent strabismus occurred in one case. Disturbance of vision was mentioned in one instance. No olfactory nor auditory disturbance is reported. The facial nerve was involved in three of the hæmiplegic cases. The reflexes were exaggerated. In only one case of transitory hæmiplegia was the Babinski sign recorded as positive.

In the large majority of cases there was incontinence of urine and feces. There were no sensory disturbances. When the convulsions cease the patient becomes stuporous or confused. He is disoriented and retarded. He does not seem to understand questions and cannot give consistent answers. The length of this period of confusion depends upon the number and severity of the convulsions. The patient slowly recovers from the mild attack, and there are no sequelæ. When the convulsions are severe a status epilepticus or profound coma may ensue. Both complications are very serious and the prognosis extremely poor. Death occurred in eighteen cases of the series. The high percentage (35 per cent.) entitles the disease to a more careful consideration.

There is nothing characteristic in pleural epilepsy to distinguish the disease from the convulsions of idiopathic epilepsy. The diagnosis is made from the negative previous history, from the physical findings, and from the fact that the convulsions develop during or immediately following surgical treatment of the pleura or pleural cavity.

REPORT OF CASES

CASE I.—G. M., male, white, forty-seven, married. Admitted to the medical wards of the Philadelphia General Hospital with the diagnosis of pneumonia. The past history has no important bearing on the case. No record of epilepsy, insanity, nor tuberculosis. He recuperated from pneumonia, but subsequently developed an empyema (left side). A thoracotomy was performed, and the cavity was irrigated every three hours with Dakin's solution. The discharge decreased

gradually, but a persistent sinus formed. It was decided to inject Beck's paste into the sinus; the paste would serve as an opaque substance for röntgenologic studies and it was believed might be of some therapeutic value. While the bismuth paste was being injected the patient suddenly collapsed. The extremities became rigid and held semiflexed. The pupils were greatly dilated, but reactive. The head and eyes were drawn to the right side, the mouth was foamy. There was no loss of sphincter control. The temperature was normal. The respirations were rapid and labored. The pulse was rapid. The reflexes were increased, but no Babinski could be demonstrated. The patient was semistuporous. He could not answer questions well. Occasionally he said a few meaningless words. In about one hour the patient had a generalized epileptiform seizure, lasting about two minutes. Morphine and atropine were given without any noticeable effect. This convulsion was followed by another period of stupor of about nine hours duration when a second convulsion occurred. In the following two hours the patient had four more convulsions. Three doses of morphine and atropine controlled these convulsions. As there had been no history of previous epilepsy, and as the blood and spinal fluid findings were negative, we concluded that we were dealing with a case of pleural epilepsy.

The patient recovered and has since reported twice for observation. The sinus has closed. He states that he feels well and does his work with fair efficiency. He has had no convulsions since his discharge from the hospital.

CASE II.—M. S., colored, male, forty-three years old, laborer. Admitted to the Philadelphia General Hospital with the diagnosis of pulmonary tuberculosis with cavitation. The patient had the characteristic history of the disease. Weakness, loss of appetite, loss of weight, nervousness, cough and expectoration, pain in the side and night sweats. He had the usual diseases of childhood. Was a heavy drinker up to three years ago. There is no history of accidents or convulsions at any period of his life. The family history is essentially negative for epilepsy. The physical examination reveals an undernourished adult with physical signs of tuberculosis of both apices and pleural effusion on the right side. The liver was slightly enlarged. The heart and other viscera showed no gross pathology. The neurological examination did not suggest the possibility of any nervous lesion. Wassermann reaction was negative.

As the pleural effusion was embarrassing the cardiac action, the attending physician decided to aspirate. As soon as the trochar was introduced, the patient had a short convulsion and died before any medication could be administered. No fluid was removed. Unfortunately a post-mortem examination was denied.

The following cases, reported by Dr. Thomas A. Shallow, from the service of Dr. J. Chalmers DaCosta, at the Jefferson Hospital:

CASE I.—Case of œsophageal fistula, in which food passed from the œsophagus into the pleural cavity, causing an empyema. Patient had three epileptiform convulsions following the passage of food through the fistulous opening into the pleural cavity. The epileptiform convulsions were followed by a short period of unconsciousness. It was necessary to perform a gastrostomy to prevent the convulsions. Patient subsequently died. Post-mortem findings showed the perforation of the œsophagus into the pleural cavity, with the secondary empyema, which was operated upon and drained. There had been no previous history of convulsions in this case.

CASE II.—Male, age thirty-five. Operated upon for empyema following an attack of pneumonia. Five days after operation, during the installation of hypertonic salt solution into the pleural cavity, the patient had several epileptiform convulsions. Installation of hypertonic salt solution was discontinued, and patient recovered without having further convulsion.

CASE III.—Male, age thirty. Operated upon for empyema. About one week after operation, during the installation of Dakin's fluid, patient developed a typical epileptiform seizure. The installation of Dakin's fluid was discontinued for ten days. Installation of Dakin's fluid was then resumed, and the patient had a second epileptic seizure. Installation of Dakin's fluid was then discontinued, and there were no further epileptic seizures. No history of previous convulsions.

In all of our cases reported and in the majority of those of the series studied the statements concerning the previous history of the patients were clear and emphatic. There was no history of previous convulsion; nor was there any history of epilepsy in the immediate family. Diseases of the cerebro-spinal system, such as neoplasms, syphilis, tuberculosis, uræmia, and the other toxæmias, were eliminated by careful examination and laboratory studies.

Anatomically we are concerned with the visceral pleura as the site of the reflex terminals. From a practical therapeutic standpoint we are concerned with both visceral and parietal pleuræ. It is believed that many of these accidents can be avoided by using a non-irritating antiseptic solution, which should be injected very slowly, and never under great pressure. The trochars should be sharp and should not penetrate the lung tissues. The use of sedatives prior to the injection is recommended. A patient with a low blood pressure should be treated with extreme precaution.

During the attack the treatment is symptomatic. Care should be taken to prevent any injury to the patient during the convulsion. Artificial respiration may be necessary. Capp and Lewis have demonstrated that there is a fall of blood pressure in many cases of reflex stimulation of a pleura and wisely advise the intravenous use of vasoconstrictors, such as, adrenalin and pituitary extracts. If the heart begins to fail, proper stimulation and support are indicated. Morphine and luminal are the most dependable sedatives. They must be given in sufficient quantities.

CONCLUSIONS

Pleural epilepsy is an epileptiform manifestation occurring when the pleural membranes are stimulated by either physical or chemical agents. It occasionally complicates the surgical treatment of empyema.

The pathology of the disease is obscure. Necropsies have not enlightened us on the subject.

The reflex theory offers the most satisfactory explanation. The reflex action is by way of the pneumogastric (the sympathetic may be involved).

It occurs in patients without previous history of convulsions. Age and race show no susceptibility, but apparently occurs more frequently in men. Low blood pressure predisposes to a fatal termination. Its occurrence does not predispose to idiopathic epilepsy.

The prognosis is guarded. Death occurs in about 35 per cent. of the cases.

Careful use of non-irritating solutions may prevent the attack, while strong sedatives and vasoconstrictors are useful during the attack.

In writing this brief review of the subject it has been our aim to remind the practicing physician, as well as the surgeon, of this epileptiform mani-

festation, which is not rare and not devoid of danger, and which may complicate the surgical treatment of empyema, or even paracentesis of the chest. We would like to emphasize the importance of blood pressure readings to eliminate cases of low blood pressure, and the therapeutic value of adrenalin, pituitrin, luminal, and morphine in the treatment of pleural epilepsy.

Our thanks are hereby expressed to Dr. Thomas Shallow for the report of his cases, and to Dr. C. N. Suravitz for his assistance in locating the references.

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MULTIPLE MYELOMA OF THE PLASMA-CELL TYPE

By ALFRED C. WOOD, M.D.

ASSISTANT PROFESSOR OF SURGERY, SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

AND

BALDWIN LUCKÉ, M.D.

ASSISTANT PROFESSOR OF PATHOLOGY, SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA,

OF PHILADELPHIA, PA.

FROM THE HOSPITAL OF THE UNIVERSITY OF PENNSYLVANIA, AND THE MCANES LABORATORY OF PATHOLOGY
UNIVERSITY OF PENNSYLVANIA

MULTIPLE myeloma is a rare form of malignant neoplasia, arising apparently simultaneously from the marrow of several bones, particularly from the ribs and vertebral column. The tumors possess marked osteoclastic but no osteoplastic tendencies; they are richly cellular, often vascular, and rarely give rise to gross metastasis. The myeloma cells are generally thought to be derivatives of the specific marrow elements.

Case Report.—A man, aged fifty-one years, was admitted to the hospital of the University of Pennsylvania, October, 1921, on account of severe pain in the back and inability to walk or even sit, as the erect position greatly aggravated the pain. He gave the following history:

On July 16, 1920, in apparent perfect health, while in the act of lifting a weight of about eighty pounds, he felt something crack in his back and he fell to the floor. He was able to get up in a short time and after resting a few hours walked to his home. He felt as though his back had been injured and rested in bed a day and a half, after which he returned to work and did not notice anything unusual, except that stooping or lifting caused pain in the back. He also noticed that, in walking, unevenness in the pavement developed the back pain and any condition causing a jar of the spine had the same effect. About a month after the first injury the man made a misstep and again fell while at work. Since this time the pain in the back has been worse and has always been aggravated by anything causing movement or strain; even coughing, sneezing and hiccupping had this effect. Shortly thereafter a lump was observed in the lumbar region and persisted for about three months. (As this had entirely disappeared, its character and relation to the present condition are uncertain.)

The patient continued to work more or less until February, 1921. The pains gradually extended upward until the dorsal region was involved as well as the lumbar, and pains through the chest began to appear. The pain and disability steadily increased, and after June, 1921, the man was able to walk very little and scarcely able to sit up. He complained of pain in his teeth, but on account of a profuse hemorrhage that had followed the extraction of a tooth on a previous occasion, he was afraid to have any others extracted. In June, 1921, he was taken a considerable distance by rail to Philadelphia for Röntgen-ray examination, after which his condition was definitely worse. He attributed this to the movements incident to the trip and the examination.

Previous Medical History.—The patient had measles, chicken-pox and whooping cough when young, and urethritis at the age of twenty-one. Since then he has had occasional attacks of sore throat and rheumatism in the legs at times. No other diseases. The patient related to a physician he had previously consulted,

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an accident to his back similar to the one above reported, fourteen or fifteen years ago, which kept him from work for one week, but he was not aware of any trouble resulting from the accident.

Social History.—The man was a foreman in a tannery; he smoked very little, not more than one or two cigars a day; did not use tea and drank one cup of coffee daily. He used alcohol very sparingly, not more than a quart a year.

Family History.—There is nothing in the family history of significance, except that a sister died of what may have been tuberculosis of the throat at the age of thirty-five. Otherwise a rather large family had maintained very excellent health. The patient has five children, all well.

Present Condition.—The chief points developed in the physical examination, in addition to the disability mentioned, were as follows: The teeth were in a very poor condition, many were missing; there was a pronounced degree of pyorrhœa, some teeth were decayed and there was some bridgework. The chest expansion was very limited, breathing being almost entirely abdominal. Showers of fine crepitant and some subcrepitant râles were heard at both bases posteriorly. A blowing presystolic and systolic murmur were heard over the apex of the heart. A lump, somewhat tender to pressure, was felt in the left mid-axillary line, apparently attached to the fifth rib. A smaller lump was felt a little higher up in the right axilla. The entire thoracic and lumbar spine was tender to pressure, but the greatest tenderness was from middorsal to the second lumbar vertebrae. Tenderness extended out to either side of the spine and over the left sacro-iliac region and the left hip.

The reflexes of both arms were normal and equal. The leg reflexes were exaggerated and ankle-clonus was present on both sides. Babinski reflex very slightly present on the left side but not on the right. The sensations were normal. Movements of the arms and legs were normal. There was some enlargement of the inguinal glands on both sides.

The prostate gland was soft, elastic, symmetrical and normal throughout. The seminal vesicles were normal.

The urine contained traces of albumin, with a few hyaline and light granular casts and occasional epithelial casts. Oxalate of lime and ammonium urate were also observed. *A careful test for Bence-Jones albumin was negative.*

Blood Examination.—Hæmoglobin, 36 per cent.; erythrocytes, 1,800,000; leucocytes, 7500; neutrophiles, 67; lymphocytes, 27; large mononuclears, 2; transitionals, 3; eosinophiles, 1; basophiles, 0 per cent.; myelocytes, 0; polychromatophilia, +; anisocytosis, ++; poikilocytosis, +; nucleated reds, 0; basic degeneration, 0. An oxydase stain was also made which failed to show any myelocytes. On October 20, 1921, the leucocyte count was 11,000, and on this date the hæmoglobin was 41 per cent; neutrophiles, 78; lymphocytes, 13; large mononuclears, 4; transitionals, 5.

A Röntgen-ray examination of the skeleton revealed a widespread process resulting in rarefaction in the vertebrae without expansion of the bones. There were numerous similar foci in both iliac bones, both femurs and the sacrum. Several ribs also showed similar areas of abnormality. There was also a suspicious area in the lower part of each humerus. From the appearance of the skeleton, shown on the Röntgen-ray films, Doctor Pancoast, professor of roentgenology at the University of Pennsylvania, reported the case to be one of multiple myeloma or metastatic carcinoma. Further study of the case led to exclude the probability of the latter condition.

On October 20th, the patient had a chill, followed by an elevation of temperature to 104.4° and pronounced dyspnoea. Examination at this time revealed the presence of bronchial breathing over both bases and a pleural friction rub on the left side. The resonance and fremitus were impaired. Many moist râles

were heard. The patient had the appearance of being very ill. The pulse showed definite weakness and dyspnoea became more urgent. The patient sank steadily from this time and died on October 24th.

Pathological Report.—The necropsy protocol (U. P., '21-459) is given here in abstract and only those organs which were definitely involved by the tumors or which appeared to have any bearing on this condition are described in detail.

Anatomical Diagnosis.—Multiple myeloma of the ribs, vertebral column and pelvic bones; slight arteriosclerosis; moderate cardiac hypertrophy and cloudy swelling; confluent lobular pneumonia of both lungs. Focal hemorrhages in spleen



FIG. 1.—Multiple myeloma. The 5th left rib. The tumor is split open; in the centre and scattered throughout the pale mass there are darker hemorrhagic areas. The periphery of the tumor is indefinite.

and atrophy of follicles; subacute tubular nephritis; paralytic dilatation of stomach; marked cloudy swelling of liver; slight fibrosis of prostate.

White male, aged fifty-one years, weighed about 85 kg. and measured 175 cm.; of average stature; well nourished; skin had a sallow tint. No external abnormalities of skull. Marked pyorrhœa and many absent teeth. Indefinite tumor mass felt on the left fifth rib; no palpable tumors over the long bones. No œdema or glandular enlargement.

Bones.—Examination of the bony structures was restricted to the ribs, vertebral column and iliac bones. The long bones and the skull could not be examined.

Ribs.—Practically all of the ribs were the seat of small gray-red tumors which eroded and replaced the bone; this rendered the ribs very fragile and slight pressure produced fracture. Three ribs contained tumors of somewhat larger size; the fourth right rib presented a growth of 7 cm. from its costal junction; this replaced for a distance of 2.5 cm. practically all of the bony structure and had caused fracture of this rib. The tumor was oval in size and measured

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2.5 x 2 x 1 cm.; it projected but slightly above the surface of the rib. Its cut surface was generally pale, gray-white and not unlike the cut surface of a lymph gland; there were, however, here and there deep red, soft, hemorrhagic areas. Two similar tumors were present in the seventh right rib, one about 4 cm. from its costal articulation, the other about 6 cm. from its junction to the vertebral column. A still larger neoplasm was located in the fifth left rib; it was oval in size, measured 2.5 x 2.5 cm., began 4 cm. from the costal junction and extended for 5.5 cm. through the body of the bone. (Fig. 1.) Apparently it completely replaced the bony structures; its cut surface was much like that of the first tumor described, that is, it appeared like that of a lymph-node with hemorrhagic softened areas. None of these larger tumors was well circumscribed but had a vague

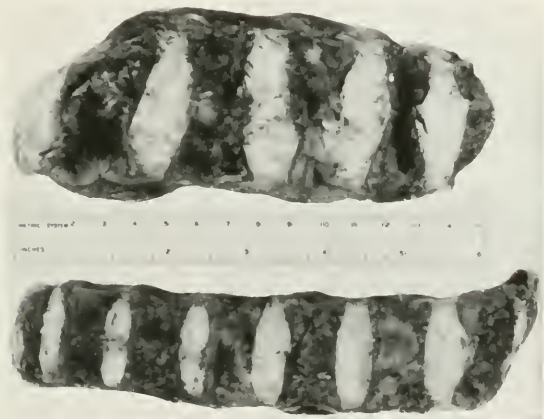


FIG. 2.—Multiple myeloma. Section through the bodies of the lumbar (thicker portion) and the thoracic vertebrae (thinner portion). The tumor has almost completely replaced the bodies of the vertebrae and partly invaded the cartilage. The mottled pale and reddish appearance of the tumor masses and the sharp contrast with the white intervertebral disk is well brought out.

periphery. Practically all of the other ribs contained small tumors. These were sometimes circumscribed, sometimes ill-defined; frequently their presence could only be demonstrated because at certain points the ribs fractured readily.

The iliac bones when dissected clean appeared normal on the outside, excepting that there were a number of smooth, non-elevated, reddish areas. These proved to be the surfaces of small tumors, which varied from 2 mm. to 10 mm. in diameter; they were scattered throughout all of the pelvic bones and at their site it was easily possible to push a blunt instrument through the bone.

Vertebral Column.—This was examined from the lower cervical vertebrae to the lower lumbar vertebrae. The bodies of all these vertebrae were completely replaced by a reddish-gray, soft tumor mass which contrasted sharply with the white intervertebral discs. (Fig. 2.) The replacement and erosion of the bones was so complete that without any difficulty all of the bodies from the cervical to the lumbar vertebrae were cut out in one piece with an ordinary knife. The spines and the lateral processes of the vertebrae were far less involved and not examined in detail. On the whole, the vertebral column appeared to be somewhat

increased in width, measuring 5.6 cm. in the lumbar portion. The tumors, on the average, measured 2 cm., while the intervertebral discs averaged 1 cm. in thickness. Only occasionally were small bits of bony spicules found. The spinal cord was readily exposed with a knife; it showed no gross abnormality and on histological examination proved to be normal.

Bone Marrow.—This was removed from the middle of the shaft of the left tibia and was found to be normally fatty.

Sections from the tumors and the various organs were fixed in 5 per cent. liquor formaldehyde and in Zencker's fluid. Paraffin sections were stained in hæmatoxylin-eosin, methylene blue-eosin, with Giemsa stain and with Mallory's

phosphotungstic acid hæmatoxylin. Frozen sections of the formalin-fixed tissues were used for Goodpasture's oxydase reaction.

Histological Examination of Tumor.—The tumors from the various places had a similar structural composition. They were all richly cellular, very vascular and poorly supplied with supporting tissue. (Fig. 3.) The latter had an irregular distribution and generally occurred in the form of delicate fibrils which divided the new growths into various-sized groups and columns of cells. There were

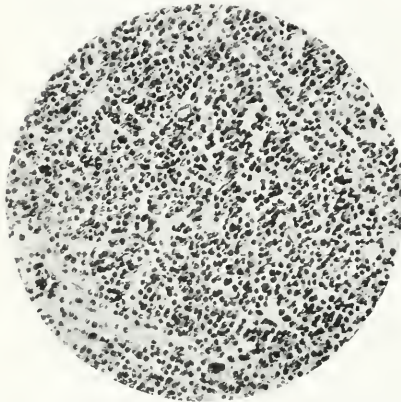


FIG. 3.—Multiple myeloma. Low-power photograph to show the richly cellular sarcoma-like structure of the tumor.

occasionally dense, wavy bundles of collagenous fibres, usually surrounding well-formed blood-vessels. In the immediate neighborhood of such bundles the fibrillar tissues were most pronounced and here a delicate network enmeshed the tumor elements. (Fig. 4.) At a distance from the coarse bundles the supporting tissue became less and less distinct and formed an ill-defined framework carrying the numerous vessels. (Fig. 5.) The calibre of the latter ranged from that of a capillary to the size of a low-power microscopic field. They were exceedingly thin-walled and, irrespective of size, were lined with a single layer of endothelial cells resting upon a delicate connective tissue. Many of the vascular spaces contained well-preserved erythrocytes, others were filled with granular precipitate and had the general appearance of huge lymph vessels. Tumor cells were often seen within the blood spaces. Only rarely were well-formed normal arteries or veins found. Some portions of the tumors were particularly vascular and here smaller and larger hemorrhages were frequently encountered. In some regions the tumor cells were widely separated by an eosin-staining homogeneous material which frequently contained typical fibrin stars and asters.

The majority of the tumor cells were of similar size; they were oval or round when loosely arranged and polygonal or irregularly formed where they were densely packed; their nuclei were usually eccentrically placed and possessed fairly distinct nucleoli. (Fig. 6.) The measurements for the formalin-fixed tumor cells average 10×6 micra; the nuclei average 4 to 5 micra. The chromatin of the

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round nuclei was somewhat condensed at the periphery, but coarse, irregular, chromatic clumps were scattered through the nuclear body. A few cells contained two nuclei. The cellular cytoplasm was slightly cloudy but almost smooth and generally basophilic; with methylene blue-eosin and with Giemsa stain, many cells were shown to possess neutrophilic and a few, eosinophilic cytoplasm. In short, the tumor elements somewhat resembled plasma cells. There were, however, certain differences. None of the tumor cells had the pale perinuclear halo so characteristic of plasma cells, nor did they give typical staining reactions.

Scattered between these plasma cell-like elements there were moderate numbers of small round cells about the size of lymphocytes, possessing a compact deep-staining nucleus and very little basophilic cytoplasm. Occasionally a field was encountered with two or three huge, irregular-shaped elements, which closely resembled megalokaryocytes. (Fig. 7.) The oxydase reaction (Goodpasture's method) was applied to frozen sections and smears from different portions of the tumor, but none of the cells presented characteristic granules. As a control, sections from a carbuncle and from an acutely inflamed appendix were used; these reacted positively.

Intervertebral Disc.—Near its junction with the tumor the cartilage was lumpy, coarsely granular or finely vacuolated; thin-walled small blood-vessels were everywhere penetrating this necrotic tissue and small hemorrhages were frequently seen. There were numerous groups and islands of cells resembling in every detail the tumor cells. No demarcation between tumor and cartilage was present; at all points, however, an irregular necrotic zone was interposed between the invading tumor and the cartilage. (Fig. 8.)

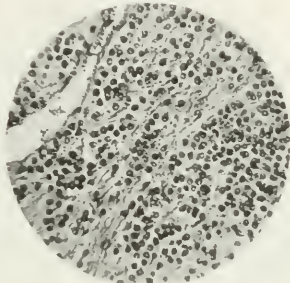


FIG. 4.—Multiple myeloma. Low-power photograph. Between the tumor cells there is shown a delicate fibrillar connective tissue. This is absent in many places.

Spleen and Liver.—In many of the blood spaces of the liver and the spleen there were occasional plasma cell-like elements which possessed the same morphology as the cells of the tumor. These occurred nowhere in groups but were always widely scattered.

Kidneys.—Left kidney weighed 200 gm. and measured 12.5 x 6 x 4 cm., and was flaccid. The capsule stripped readily, leaving a mottled, pale, yellow-brown, smooth surface. The cut surfaces were somewhat moist, the edges quite swollen. The cortical zone averaged 10 mm., was pale, yellow-brown and turbid. The glomeruli and striations were fairly distinct. The striations of the medulla were plainly marked. The right kidney resembled its fellow. Histologically the capsule was moderately thickened. Just beneath it and extending into the outer zone of the cortex there were small, irregular, cellular areas composed mainly of small round cells resembling lymphocytes and occasional larger elements, with rather pale, indented or oval nuclei; these the writers take for endothelial leucocytes. A very occasional polymorphonuclear leucocyte was encountered. The tubules in such cellular regions were compressed. There was a very slight focal, intertubular fibrosis accompanied by a lymphocytic infiltration. Many glomeruli possessed a thickened capsule, others were fibrosed and hyalinized, while yet others were small and atrophic. The majority of the tufts, however, were of large size; their coils were engorged, but did not contain foreign cells; there was no proliferation of the

capsular epithelium. The arteries had irregularly thickened, partly hyalinized media, but no conspicuous narrowing of the arterial lumina was present. The capillaries were well filled in the medulla and inconspicuous in the cortex. The convoluted tubules had poorly staining, frequently anuclear lining; most of the cells contained fine to moderately coarse hyaline droplets and minute vacuoles. The cells of the tubules of Henle were pale staining, but otherwise fairly well preserved; the collecting tubules appeared quite normal.

Discussion.—Multiple myeloma is a very rare type of new growth. Wallgren,² in 1920, collected all the reported cases in which the clinical diagnosis had been sustained by histological examination. He found 105 and added to this number 13 new cases which he had studied himself.

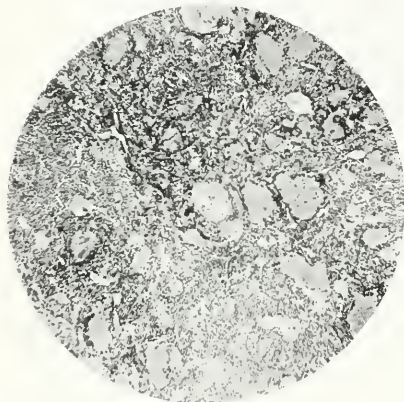


FIG. 5.—Multiple myeloma. Low-power photograph showing many large and thin-walled blood channels. The vascularity varied considerably in different portions of the tumor.

Symmers³ encountered only 3 cases among 6000 autopsies in the Bellevue Hospital, New York. The age and sex incidence have been analyzed by Wallgren in 98 histologically proved cases of the disease; there were 66 men and 32 women. The most frequent age period at which the symptoms first appeared was from forty-five to sixty-five years; the youngest case reported in the literature was twenty-two and the oldest eighty years. Wallgren's monograph is so recent, and deals so thoroughly with all phases of the subject, that

we shall merely discuss briefly certain points of interest in the case reported above.

Relation of Traumatisms to Myeloma.—The patient gave a history of an ancient injury to his back and a recent injury which precipitated his symptoms. In the literature a similar relation between trauma and myeloma is frequently recorded, and this is of interest not only etiologically but from the medico-legal standpoint. In the case here reported, the insurance company which had assumed the liability of the patient's employer was very insistent on obtaining an opinion as to whether the patient's condition was due to the accident described. Inasmuch as most states have workmen's compensation laws at the present time, and as most workmen receive some injury from time to time, this point becomes one of major importance. An analysis of the reported cases of myeloma gives us the impression that the injured bone was already diseased and that the traumatism merely called forth definite symptoms.

Absence of Bence-Jones Protein from the Urine.—Through a misunderstanding but a single examination for Bence-Jones albumose was carried out, but this was most carefully made by Dr. Thomas A. Cope, an experienced laboratory investigator. The negative result is not incompatible with the disease, for, as Boggs and Guthrie⁴ and others have shown, this albumose may be absent in undoubted cases of myeloma. On the other hand, its occurrence is not limited to this disease but it may be present in destructive processes of the marrow due to any cause, such as carcinomatous or sarcomatous invasion, osteomyelitis or chronic myelogenous leukæmia. Wallgren tabulates 51 cases of myeloma in which the urine contained albumin and in which tests for Bence-Jones protein were made. In 42 of these the albumose was present, and in 7 it was absent.

Diagnosis of Myeloma.—The symptom which brings the patient to the physician is usually, as also in our case, pain; quite often this begins suddenly and violently, but sometimes it is at first relatively light and gradually increases in severity as the disease progresses, until the slightest exertion may bring about excruciating suffering. In our case even sneezing or coughing produced this result. The appearance of an eroding bone tumor, which often leads to spontaneous fractures, is common, but sometimes the neoplasms may so

diffusely infiltrate the marrow cavities as to cause no demonstrable swelling.

Most important is the information obtained from the Röntgen-ray examination, but in order to be of value it must be carried out by a person thoroughly versed in radiographic technic. This fact was well shown in the case here reported. Röntgen-ray plates had been taken four months prior to coming under our observation by an experienced röntgenologist, who reported fracture of the spine; the plates were also examined by a number of surgeons, who apparently did not suspect the possibility of the presence of myeloma. Referring to this point, Symmers, in the article mentioned, says: "In the case of diffuse metastatic or myelomatous infiltration of the marrow the Röntgen-ray sometimes is powerless to register a shadow." The observation we desire to make here is that when the patient was admitted to the University Hospital, bringing with him the Röntgen-ray plates taken four months previously, Doctor Pancoast was able to make the diagnosis of multiple myeloma or

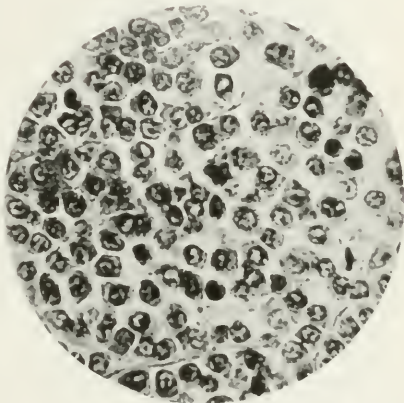


FIG. 6. Multiple myeloma. High-power photomicrograph showing the plasma cell-like character of the myeloma cells.

metastatic carcinoma from these. Röntgenological studies made at the University Hospital after admission confirmed this opinion. Inasmuch as there was no evidence of a primary carcinoma having existed, and on account of the other factors present, it seemed reasonable to settle on a diagnosis of myeloma. It will be understood, however, that in order to arrive at a correct opinion the Röntgen-ray must show in detail the structure of the bones examined and the plates must be read by a person who can detect abnormal difference in density even though slight. The most characteristic

feature appears to be a diminished density, due to the absorption of lime salt, which is replaced by the tumor tissue.

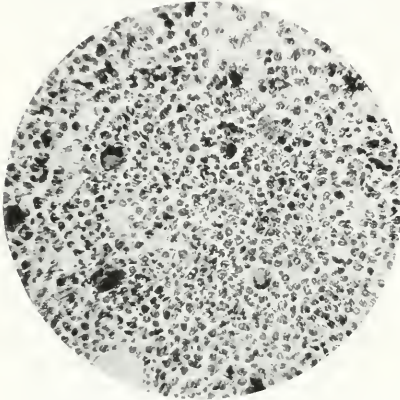


FIG. 7.—Multiple myeloma. Low-power photograph showing several large, irregularly nucleated cells which resemble megalokaryocytes.

Information of diagnostic value may be obtained from examination of the blood. In most of the reported cases there was a marked diminution in the number of erythrocytes and a correspondingly marked reduction in the percentage of hæmoglobin. The white cells usually exhibited no distinct changes, there being neither a definite alteration of the total nor of the differential leucocyte count. Tumor cells have occasionally been reported in the peripheral blood stream. Indeed, it is surprising that in view of the great vascularity of the neoplasms and the frequent presence of myeloma cells within the blood channels of the tumor such cells are not more often encountered in the peripheral circulation. In our case numbers of myeloma cells were present in the spleen and in the liver; it is possible that they undergo destruction in these organs.

The frequent coexistence of nephritis and myeloma has been emphasized, and Wallgren even hints at a possible distinct relation between these affections. In any case it is to be borne in mind that most sufferers of myeloma are likewise afflicted with a more or less severe renal disease.

Lastly, it must be thoroughly understood that there is no essential clinical difference between myeloma and other primary tumors involving the skeleton. The combinations of pain, bone deformity, spontaneous fracture, the existence of Bence-Jones albumosuria, the marked anemia and the practically unchanged white cell count, together with the Röntgen-ray picture, should direct attention to this disease. The final and absolute diagnosis at present must still rest upon a histological examination of the tissue.

MULTIPLE MYELOMA OF THE PLASMA-CELL TYPE

Treatment.—Greenough and his associates⁵ report 9 cases of myeloma appearing in the records of the Massachusetts General Hospital and Collis P. Huntington Hospital from January 1, 1911, to January 1, 1921, but pathological proof of the diagnosis was obtained in only 3. These 3 cases showed the microscopic picture of plasma-cell myeloma, but in none did it appear to be systemic, and Bence-Jones albumose was never demonstrated. Two were instances of solitary foci of disease, one in the ilium and the other in the humerus.

The first case died of hemorrhage after an exploratory operation. The second case was alive and well three months after incision and curettage. The third case is of interest in that the tumor appeared first in the orbit; two excisions were performed with enucleation of the eye. Two years later another tumor developed in the lower jaw. This was excised, recurred and was again excised, and the cavity treated by radium insertion. The case is now two years under observation without recurrence.

It is still an open question as to whether myeloma is always multiple, for the earlier stages are rarely seen, or whether a "solitary" and a "multiple" type exist. Surgically the treatment of multiple myeloma at present seems to be hopeless.

The Nature of Myeloma.

It is not known whether multiple myeloma belongs to the class of true tumors or whether the disease is a tumor-like systemic affection. The arguments brought forward to support this or that belief seem to be inconclusive, but the majority of observers at present classify the condition as a neoplasia.

The type cell of multiple myeloma has been variously regarded as being identical with or related to the plasma cell, myeloblast, myelocyte, lymphocyte, erythroblast and osteoblast, and the corresponding tumors have been named, respectively, plasmacytoma, myeloblastoma, etc. Most types of myeloma were, however, regarded as belonging to these two varieties. In Wallgren's 13 cases the cells of the tumors closely simulated plasma cells, but they equally closely resembled myeloblasts; this has been true in many other reported cases, and many observers seem to have been uncertain as to whether the tumors belong to the plasma cell or the myeloblastic type. The oxydase reaction has

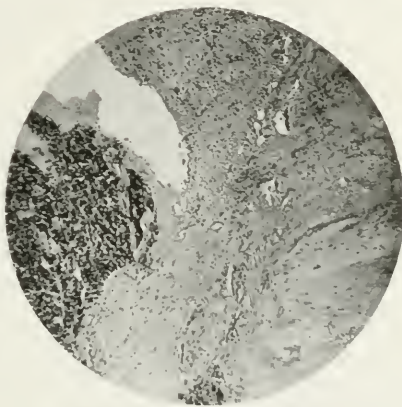


FIG. 8.—Multiple myeloma. Junction of tumor and intervertebral disk. Note the invasion of the somewhat necrotic cartilages by the tumor cells. The hemorrhages described in the text are not shown in the photograph.

frequently been employed for differentiation, but it has lately been emphasized that this reaction is insufficient for such a purpose. A negative reaction does not prove the tumor not myeloblastic in origin. Christian,⁶ who had an opportunity to examine 11 cases, some of which had been previously published under different titles, believes that the tumor elements were all of the same type. Wallgren believes that the cells composing myeloma are best called by the indifferent name "myeloma cells," and that the classification into plasma cell and myeloblastic type should be discontinued.

As to those tumors which have been named lymphocytoma, erythroblastoma and myelocytoma, he believes that the cell types have probably been misinterpreted, and he states particularly that no cases of the undoubted lymphocytic cell types of myeloma have been reported in the last twenty years; differences in fixing and staining methods are possibly responsible for the diversity of interpretation. Morse⁷ recently studied three cases of multiple myeloma and discusses the histogenesis of these tumors; he presents data to support his theory that the "plasma-cell myelomata" spring from a series of cells whose specific function is bone absorption and that the myeloma cell may be a heteroplastic osteoblast. We have carefully compared the cell types of our case with those illustrated in various papers on the subject, and we feel that the tumor cells of the case reported very closely resemble those of most of the other recorded cases, no matter whether such cases have been looked upon as being of the plasma cell or of the myeloblastic type. If we, in spite of our conviction that the cells of myeloma are of an indifferent type and should not be regarded as either plasma cells or myeloblasts, report our case as a "plasma-cell type" of myeloma, we do so in view of Morse's important theory mentioned above. The moderate number of small round cells which were found scattered throughout the tumors are regarded by us as being reactive lymphocytes. Similar elements are practically always found in any type of tumor and particularly at its periphery. The large cells which resembled megalokaryocytes are probably remnants of the destroyed marrow or they may be conveyed to the neoplasm through its many blood channels, which in all likelihood communicate to a certain extent with the blood channels of the marrow.

It is interesting that in our case, as well as in many of those reported, there were undoubted transported tumor cells in the spleen and in the liver. Probably it is in the rare instances in which these cells are not destroyed in the organs mentioned that gross metastases have been found.

Lastly some mention must be made of the well-marked subacute nephritis in this case. At present it seems unlikely that the frequent coexistence of nephritis and myeloma should be anything but an accidental one, or at most, due to the abnormal proteins formed by these tumors.

Summary.—A white man, aged fifty-one years, and hitherto in apparent health, fell suddenly to the floor while lifting a heavy weight. Since that time he suffered from pain in the back exaggerated by the slightest motion and exertion. A few months later similar pains occurred in the chest.

After a long railroad journey his condition became much worse and he finally was unable to sit or walk because of extreme pain in the back or chest. A Röntgen-ray examination showed a widespread rarefaction of the lumbar vertebrae, the ribs and pelvic girdle and both femurs. Tender lumps could be felt over several of the ribs. The urine contained traces of albumin but no Bence-Jones protein. There was a profound anemia but no definite change in the white cells. The patient died of pneumonia. The post-mortem examination disclosed numerous soft, gray-red tumors in the ribs, the vertebral column and other portions of the skeleton, which had partly eroded the bones and rendered them very fragile. The vertebral column in particular was much involved, the bodies of the vertebrae being almost completely replaced by tumor masses. Histologically, the neoplasms were richly cellular, contained very little supporting tissue and were composed chiefly of elements which somewhat resembled plasma cells; these did not give an oxydase reaction. Similar cells were found in the blood spaces of the spleen and the capillaries of the liver.

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TRAUMATIC LESIONS OF THE HEAD*

By THOMAS A. SHALLOW, M.D.

OF PHILADELPHIA, PA.

WE are constantly confronted with problems in head injuries as to the best procedure to follow, realizing that the slightest traumatism may cause a fatal lesion and an apparently severe traumatism may be associated with very little pathological change. Etiology, therefore, deserves comparatively little consideration from a diagnostic viewpoint. We must consider particularly four factors. First, injury to the brain substance; second, hemorrhage from the pia-arachnoid; third, injuries to the skull proper; and fourth, meningeal hemorrhage.

In taking up the first of these subdivisions, we see most frequently concussion, associated with cerebral lacerations and cerebral hemorrhage of the smaller vessels in the substance of the brain. If you believe that concussion is the result of a molecular disturbance or a chemical change in the brain cells and that the irritation brought about by the injury resulting from this disturbance varies in its duration from a few seconds to a number of hours, or, if you believe that concussion is associated with lacerations of the brain; punctate hemorrhages or contusion of brain, a view held by Duret, Keen and Kocher, you may find a certain basis of truth in both arguments.

In support of the first theory, it can be stated that in a majority of head injuries there is a transient loss of consciousness, lasting from a few seconds to several minutes, at the expiration of which time consciousness is entirely regained. On examining such a patient we observe a slow and low tension pulse, pupils which react promptly to light, a subnormal temperature and no disturbance in respiration. It certainly seems with these transient symptoms that very little organic change has occurred in the brain substance. On the other hand, in the more severe cases we find that unconsciousness is prolonged, that the patient's pulse may be as low as 60 or less and the blood-pressure proportionately low and the patient regains consciousness after hours of quiet unconsciousness.

In support of the second view we may cite the type of case in which the patient lies curled in the bed in a position of acute flexion. We attempt to examine the pupils and the individual tightly closes the eyelids, twists the head and moves the hands in an effort to push you from him. He resists movements of the hands and the legs but can usually be partially roused by shouting and pinching. These patients are then showing the symptoms of laceration and hemorrhage of the brain, and in their present state an eye-ground examination, necessary to an accurate diagnosis of intracerebral pressure, is almost impossible to make. The pulse in these cases varies between 60 and 90

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and is of low tension. One pupil may be dilated and the other contracted but they will both react to light, although not with the same degree of promptness as in pure concussion. We treat these patients by repeated lumbar puncture and drainage of the spinal theca every twelfth hour.

When stupor has lasted for hours, and the hours have stretched into days, should we, in the absence of ability to determine what associated signs or symptoms are hidden beneath this mask of stupor or semiconsciousness, jump to a conclusion? Should we pin our faith to the manifestation of the influence of pressure on one nerve, the oculomotor, when we have eleven other nerves subject to equal amount of damage as a result of pressure, but whose symptoms of disturbance are neither evident to the examining eye, as in the case of the oculomotor, nor can be elicited from an insensible patient? Where the pressure is insufficient to cause death and the patient recovers consciousness, at the end of days or weeks, blindness, deafness, epilepsy, muscular paralysis, change of character or insanity or some other effect of pressure may be present. Do you not think in such cases the pathological process must extend beyond anything that can be termed "concussion" and such cases are instances of subdural hemorrhage?

In support of these statements the following cases are submitted:

CASE REPORTS

CASE I—R. B., age forty-eight, history No. 340. Chief complaint epileptic seizures. He gave a history of having been injured twenty-one years ago when he was struck on the head by a piece of falling iron. Then for five days he was unconscious. These convulsions had been present for eighteen years, having had their onset three years after the accident. They continued as generalized convulsions for fourteen years, on the average of two to three weeks apart, until four years ago when, in addition to the generalized attacks which now became infrequent, he had convulsions which were limited to the left arm and not associated with loss of consciousness, except on rare occasions. The arm first twitched, then was convulsed and the patient turned his head towards the left and had double vision. Diagnosis by Professor Dercum of Jacksonian epilepsy. Examination was negative as to choked disc and optic atrophy. Operation November 4, 1922; osteoplastic flap, over the right motor area. A collection of fluid in the subarachnoid space covered the whole motor area and upon examination looked exactly as a chemosis would look in the conjunctiva. This area collapsed upon inserting the finger and freeing the adhesions. Immediately following the operation he had a number of convulsions but did not have any additional ones until two weeks ago when he had another attack of the generalized type. This case is not cited as a success in the treatment of epilepsy, but as an example of early conservative treatment resulting in years of epileptic seizures which might have been prevented by prompt radical intervention.

CASE II—A. C., age forty-five, history No. L 881, came to the hospital complaining of pain in the left side of the head and spasticity of the right arm and leg. In November of 1920, he was struck while unloading a car of stone. He was unconscious for a number of hours. He was then taken to an hospital, where two operations were performed a number of weeks after his injury. Examination was negative as to choked disc and optic atrophy. A third operation was undertaken in Jefferson Hospital because it was thought that there was still some pressure upon the motor area of the left side. The dura was found to

be greatly thickened (external pachymeningitis); there was no evidence that the dura had ever been opened. The dura was then opened. As in the former case, there was an encysted collection of fluid over the left motor area which collapsed on splitting the adhesions. A piece of cow's horn was transplanted to fill in the cavity left by the previous operations. Within ten days the man was able to grip objects with the right hand and, at the end of sixteen days, was able to walk without a cane.

These two cases clearly indicate that, following a head injury, unconsciousness over a period of a few hours should lead the surgeon to suspect that he is dealing with more than pure concussion and with more than a trivial laceration or contusion of the brain. Had a lumbar puncture been performed upon these two cases, bloody fluid, no doubt, would have been found and prompt drainage of the subdural space, by means of a subtemporal decompression, might have prevented these serious results.

In a case where a definite fracture of the skull exists either in the vault or the base, we are again confronted with the question of operation. In fracture of the skull we are taught by some that we should not operate unless there is definite evidence of compression, manifested frequently by a pupil which fails to react to light, by a pulse-rate of 60 or under and by a blood-pressure which is higher than normal and is becoming higher; these manifestations occurring in a patient who has not returned to consciousness, unconsciousness being associated with beginning stertorous respiration. The following cases are cited as additional witnesses to the fact that disastrous pressure may exist within the dura without the classical clinical manifestations of compression.

CASE REPORTS

C. P., age forty-one, history No. L 5800, whose chief complaints were failure of vision in the right eye, impaired use of the left arm and leg and spasticity in both. This man fell from a tree in July, 1922, and was taken to an hospital where he lay in a stupor or a semi-conscious condition for seven days and was discharged at the end of one month. No operation was performed. An eye ground examination by Dr. W. M. Sweet was made January 15, 1923, six months after the injury and showed that the pupil of the right eye did not react. He has vision for moving objects and has advanced primary optic atrophy. In the left eye the pupillary reaction required one minute. Diagnosis: (1) Fracture of base of skull, hemorrhage into optic nerve in front of chiasm; (2) subdural hemorrhage causing spasticity of left arm and leg. No operation was performed.

S. P., age thirty-four, history No. L 2080, was brought to the Jefferson Hospital on August 22, 1922. He was unconscious, pupils reacted to light but the eyes showed nystagmus both rotary and lateral. There was a discharge of a large quantity of thin, bloody fluid from the left ear. He reacted from his concussion within two hours. The nystagmus lasted twenty-four hours. The X-ray examination showed that he had a linear fracture running through the left parietal bone and involving the base of the middle fossa. There were no definite signs of compression, that is to say, the pupils both reacted, although the left less promptly than the right. The pulse, while it was 70, was of low tension. His breathing was regular and not stertorous. An eye ground examination taken at this time showed no evidence other than a slight hyperemia of the left disc, and full, tortuous veins. The patient was kept in bed fourteen days. When he

attempted to walk he had marked ataxia, a positive Rhomberg and exaggerated knee jerks. There was neither a Babinski nor clonus, and he was unable to hear out of the left ear. Eye ground examination again taken showed that the discs were hyperemic and the margins indistinct, suggesting pressure. Operation one month later. Subdural decompression on the left side revealed an encysted collection of slightly colored fluid in the subarachnoid space. The patient was able to leave the hospital several weeks after the operation and he says that he is still dizzy, has ringing in the left ear, hears with difficulty and has disturbance of equilibrium. His deafness was due to injury to the cochlear nerve and his disturbance of equilibrium, vertigo and tinnitus were due to irritation in the vestibular nerve caused by hemorrhage into the labyrinth.

H. C., age fifty-five, history No. J 3292, was brought to the Jefferson Hospital, November 2, 1920, having been struck by an automobile. On admission he was unconscious, reacted in one hour, following which he was confused, incoherent; and not until the end of four days was able to recognize his sister. His pulse rate fell to 54, his blood-pressure was 140, and his pupils reacted to light, and it was, therefore, concluded that he was in a state of concussion. Within three hours, the pulse rate rose to 60 and the following day was 72. The blood-pressure never increased. Two days following admission Battle's sign (longitudinal ecchymosis over mastoid) was noted. Eye report, November 3rd; pupils equal and react to light. Eye ground normal. November 6th, three days afterward, he had hyperemia of the left disc and retina. November 12, 1920, hyperemia persisted. November 21, 1920, low grade optic neuritis is still present. November 29, 1920, low grade neuritis persists. Examination by Professor Dercum showed traumatic confusion. He was discharged at the end of one month little improved but was able to walk fairly well.

It is by no means the purpose of this paper to convey the impression that all fractures of the skull should be trephined. The following is an example of the class of cases which requires no operative interference.

I. B., age fifty-one, history No. L 3988, was struck by an automobile, December, 1922. He was unconscious and had bleeding from right ear. Following one hour of unconsciousness he was in a stupor for a number of hours, after which he gradually returned to consciousness. The pulse rate was 70, the blood-pressure 150. The X-ray showed a linear fracture of the left parietal bone which extended into the mastoid. There was no operation. Result: complete recovery.

It is difficult to discuss head injuries without some reference, however brief, to meningeal hemorrhage. The symptoms of this can be classified as secondary unconsciousness occurring after a period of primary unconsciousness associated with symptoms of compression.

Our plan of procedure in all head injuries is to observe hourly temperature, pulse and blood-pressure, to rouse the patient, and if possible, to get him to count up to twenty. If he is stuporous, irritable and is not able to follow our train of reasoning, the nurse or the resident physician is instructed to observe the respiration. If the patient can no longer be aroused, if his respirations become stertorous, if he shows signs of cortical irritation (rigidity of an arm or of a leg, convulsions, etc.), if the pupil is dilated and fails to react, or if he has a slow, high-tension pulse, a diagnosis of extradural hemorrhage is made.

We call attention to E. L., history No. J 4180, who fell on a slippery pavement and was brought to the station house, supposedly drunk. The following day he was admitted to the Jefferson Hospital with spasticity of the left arm and leg. His right pupil at first reacted sluggishly to light and within six hours was dilated and failed to react to light. He was not entirely unconscious but could be roused. On admission his pulse rate was 72, which in the course of six hours fell to 40. Blood-pressure on admission was 160 which fell to 140. It is interesting to note here that the blood-pressure did not rise with the pulse fall. Operation disclosed hemorrhage from the anterior and posterior branches of the meningeal artery. He made an uneventful recovery with the exception of an epileptic seizure which occurred six months after the operation; there has been none since.

CASE REPORTS

M. M., history No. K 121. Cause: automobile accident. On admission patient was unconscious. Stertorous respiration, pulse rate 52, blood-pressure 120. Operation revealed depressed fracture of the parietal bone, subdural and extradural hemorrhage. Terminated fatally seven days after operation.

H. P., history No. L 5458. Cause: struck by automobile. Unconscious several minutes. Pulse rate 54, blood-pressure 120. Eye ground normal. X-ray diagnosis: linear right parietal fracture extending into base. No operation. Recovered.

R. M. Cause: gun-shot wound of left frontal region of head. Patient entirely conscious with lodged bullet. Facial palsy. Eye ground: low grade optic neuritis. X-ray findings: fragment of bone had penetrated and lodged in frontal lobe on right side. There are several small fragments of bone along the course of the bullet which is lodged behind the motor area. Operation: removed the bullet and bone fragments; osteoplastic flap. Result: discharged with no apparent bad effect.

R. T., age nineteen, history No. 4062. Cause: fell three stories. On admission (3 P.M.) patient was unconscious. Reacted from unconsciousness and went into irritable stupor. Right pupil reacted promptly, the left more slowly. The stupor became more pronounced and at 10 P.M., seven hours after admission, he could be roused with great difficulty. The left pupil still reacted very sluggishly. The spinal puncture showed blood in the spinal fluid. Pulse on admission was 70, blood-pressure 120. Pulse gradually fell to 56 and blood-pressure rose to 140. Operation showed a depressed fracture of the left occipital and parietal bone. Extensive extradural hemorrhage and laceration of cortex of brain. Recovery.

Thomas D., age thirty, history No. J 6637. Cause: fell from second story window. On admission unconsciousness profound. Stertorous respiration. Right pupil dilated and did not respond to light; left pupil moderately dilated with sluggish reaction. Cerebrospinal fluid bloody. Pulse rate 64; blood-pressure 100. Operation showed a fracture of the parietal bone, extradural and subdural hemorrhage. Recovered.

D. F., age six, history No. K 4784. Cause: struck by automobile. On admission profound coma. Pulse rate 100, blood-pressure not taken. Temperature $100\frac{1}{2}^{\circ}$. Right pupil widely dilated; did not react to light. Left pupil dilated but reacted to light. At operation there was no evidence of fracture or extradural hemorrhage. Discoloration beneath the dura which was incised. Large quantity of bloody cerebral fluid, dark in color. Recovered.

M. K., age thirty-five, history No. J 1907. Cause: fell five stories. On admission, profound coma, stertorous respiration. Left pupil widely dilated and did not react to light. Right side of body rigid and there were two convulsions on the way to operating room. Operation revealed a fracture of the left parietal

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bone extending to base. Extensive subdural hemorrhage. Result: Patient died on table.

G. S., history No. K 2571. Cause: struck by trolley car. Symptoms: profound unconsciousness. Stertorous respiration. Left pupil moderately dilated; reacted sluggishly to light. Right pupil dilated and reacted to light. Pulse rate 71, blood-pressure 160. Thirty minutes after admission pupil still reacted to light very sluggishly. Pulse rate rose from 70 to 120 and the blood-pressure fell from 160 to 118. Operation showed a comminuted fracture of the left parietal bone which extended into the base. An extensive extradural hemorrhage. The dura was distended before incision and showed a bluish discoloration beneath. Drainage. Result: recovery. He had mental confusion and had to be restrained for four days following the operation.

J. R., age twenty-four. Fell from a scaffold three floors high. Upon admission profound coma. Pupils reacted. Lumbar puncture showed bloody cerebrospinal fluid. Operation revealed fracture left of parietal region. Subtemporal decompression left side. Blood-pressure and pulse were not elevated. Result: recovery.

J. D., age six. Cause: automobile accident. On admission profound coma. Generalized convulsions. Right pupil widely dilated and did not react. Fracture of the right parietal region extending into the base. Operation: four decompressions, two on each side with drainage on each side. Result: recovery.

THE COMBINED ABDOMINO-THORACIC APPROACH IN OPERATIONS FOR DIAPHRAGMATIC HERNIA

BY HARVEY B. STONE, M.D.

OF BALTIMORE, MD.

THE subject of diaphragmatic hernia has received extensive attention within the last five years. As many writers have suggested, this increased interest in what was formerly considered a very rare condition is due to two factors, the increased use of the Röntgen-ray as a method of diagnosis and the numerous war wounds of the diaphragm which were followed by diaphragmatic hernia.

It is not the purpose of this article to enter into an extensive review of the literature on this subject. A very recent article by Truesdale¹ reviewed the subject quite completely and carried with it a bibliography of the recent literature. In addition to this an article by Frank² contains a further extensive collection of references. As a medical condition becomes recognized with increasing frequency, interest shifts from its rarity and is diverted to the question of treatment. The purpose of this paper is to call attention particularly to the best method of procedure in dealing with this type of hernia.

There have been in general three methods of operative approach employed—the abdominal, the thoracic, and the combined abdominal and thoracic. The combined approach has been described chiefly in the French literature, particularly by Auvray.³ His is a much more formidable operation than the one which the present writer wishes to advocate, and will be considered in detail a little later.

To present the facts on which this paper is based the following case is briefly outlined, special emphasis being placed upon the operative difficulties encountered and the conclusions derived from them:

A soldier, S. L., was admitted to Base Hospital 18, A. E. F., March 2, 1918, with definite signs of acute intestinal obstruction of three days' duration. There was no history of wound or any other injury and no marks or scars on his body. An exploratory laparotomy was done through a lower right rectus incision by Dr. Charles H. Watt, one of the officers on the surgical service. The small intestine, the ascending colon and transverse colon were found to be distended while the descending colon and sigmoid were found to be collapsed. The distended bowel was traced around to the neighborhood of the splenic flexure. At this point the bowel seemed to be caught in some manner not easily determined because of its inaccessible position from the incision. Traction was made on the distended bowel, without great force being used, and the obstruction was felt to give way, following which gas and liquid contents moved down into the descending colon. It was felt that the obstruction was definitely relieved, and while the precise nature of the trouble could only be surmised it was supposed that adhesions which had kinked the bowel had been released or a volvulus untwisted, thus freeing the obstruction. The incision was closed and the patient progressed fairly favorably for several days, when the obstruction again returned accompanied by distention, crampy pains and vomiting.

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The fact that the trouble had been in the splenic flexure, close under the diaphragm, then suggested that the case might have been one of diaphragmatic hernia. Dr. C. G. Guthrie, chief of the medical service, examined the patient in consultation and found a tympanitic area in the left chest. Feeling quite sure that the case was a diaphragmatic hernia we proceeded to have a fluoroscopic examination made by Dr. Charles A. Waters, which showed a definite dome-shaped mass, above the diaphragm in the left side of the chest, which descended with inspiration. It was at once decided to operate on the patient, and this time operation was done by the writer, with the help of Doctor Watt, on March 7, 1918. A high left rectus incision was made and the splenic flexure was found to pass into the chest through a small hole in the dome of the left half of the diaphragm. The bowel was very tightly incarcerated in the opening through the diaphragm and did not yield to very determined efforts to draw it downward. In short we were confronted with an irreducible hernia.

It was evidently necessary to divide the edge of the diaphragmatic aperture so as to release the incarcerated bowel. However, this proved to be a very formidable task. The point to be reached was high up under the dome of the diaphragm. The costal margin was in the way, and distended bowel further complicated the difficulties. The neck of the hernia could not be seen, and to pass a knife upward and cut by blind touch was regarded as an extremely dangerous procedure. Before the operation it had been considered wise to prepare the patient's chest as well as his abdomen, with the possibility in mind that it would become necessary to open the chest. When the condition just described was found, it was decided without further delay to do an immediate thoracotomy. The left hand was kept in the abdomen and pushed upward against the chest wall at the level of the hole in the diaphragm. This enabled the operator to judge exactly which rib would give best access to the part of the diaphragm in which the hernia was situated. This rib, which turned out to be the sixth, was then exposed by a six-inch incision along its course. The rib was resected subperiosteally and the left pleural cavity was opened. Immediately the strangulated loop of bowel, which happened to be the splenic flexure of the colon, was presented to view. Another effort was made to reduce the bowel, by traction with the left hand in the abdomen and pressure with the right hand in the chest. This again failed. Then the index-finger of the left hand was used to lift the diaphragm upward toward the incision in the chest wall, pushing upward under the diaphragm, just at the edge of the defect. With the knife in the right hand the margin of the defect was carefully divided, the left hand acting as a support and guard underneath, doing away with any danger of cutting into abdominal viscera. This permitted the easy reduction of the loop of bowel. The reduced splenic flexure was then carefully examined and found to recover its color quickly, and was considered to be perfectly safe to replace in the abdomen. The edge of the defect was also examined. The hernia was of the so-called false congenital type. That is to say, there was no sac and the pleura and peritoneum were continuous across the smooth, rounded edges of a hole about $1\frac{1}{2}$ cm. in diameter. The hole was now closed with interrupted sutures of catgut. This closure was also greatly facilitated by having the two incisions. The sutures were placed from above through the thoracic incision, but the left hand was kept in the abdomen supporting the diaphragm from below, so as to bring it well up into the wound, and also acting as a darning ball to prevent the stitches catching any of the abdominal contents. Both the chest and abdominal incisions were then closed without drainage. The patient made an uninterrupted recovery in the same length of time that would be required for any other ordinary abdominal operation. A dry pericardial rub, lasting a few days, and some evidence of pleural thickening did not delay his convalescence.

The case herewith reported has already received passing mention in the literature, being referred to by Jopson in a discussion of the paper by Matthews and Imboden.⁴

To resume the consideration of the best operative attack in cases of diaphragmatic hernia: The abdominal approach has certain definite advantages. It affords necessary knowledge as to the condition of the abdominal viscera and permits the performance of any resections, repairs or suture that may be required by the condition of these viscera. In all cases of hernia which come in with acute intestinal obstruction, and in those traumatic cases in which a missile has traversed the chest and diaphragm and then penetrated the abdomen, it may be considered absolutely essential to explore the abdomen. With these definite features in its favor it has equally definite drawbacks. The dome of the diaphragm is mechanically very inaccessible from below. The reduction of the hernia is rendered difficult not only by this mechanical situation, but also by the suction of the negative pressure in the chest and by possible adhesions within the thorax, and the suturing of the defect presents the unfavorable mechanical features of a closure done on the concave rather than the convex surface of the diaphragm. The thoracic approach alone, has the advantage of a much more immediate access to the site of the trouble and does away with the negative pressure of the pleural cavity, and so makes reduction easier and gives a much better field for suture of the hernial opening. It might be the method of choice in those cases of congenital hernia not acutely obstructed which are diagnosed before operation. Until the present time, however, this has been by far the smallest group of cases which come to operation, the great majority being those with acute obstructive symptoms not diagnosed before operation and those following traumatism. As has just been pointed out, it is particularly in these classes of cases that exploration of the abdomen is so essential. It would be impossible, broadly speaking, to repair or even to recognize serious intraabdominal lesions through the thoracic incision alone. Without going into numerous case references, it may be said that the literature of diaphragmatic hernia presents ample support for the statements just made.

The combined abdominal and thoracic approach obviously affords all the advantages offered by either method alone. As in the case herewith reported, it greatly facilitates the necessary steps of the operation, and at the same time gives opportunity for a complete inspection of the whole field involved. It was these considerations which led certain French surgeons to advocate the combined operation, notably Berard and Auvray. The latter has reported the use of an incision beginning as a thoracotomy, then continued downward over the anterior abdominal wall, dividing in its course the costal margin, the anterior abdominal wall itself, and the diaphragm down to the opening of the hernia, thus laying the two cavities broadly open by one extensive incision. While the principle of a double approach seems to the present writer to be the proper solution of the difficulties involved, nevertheless this particular application of it impresses one as being entirely too radical in its execution and unnecessarily

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damaging to important structures, particularly the costal margin. On the other hand, it does not seem to add a single advantage over the method herewith described, which consists of two simultaneous but separate incisions. As to possible disadvantages of the combined operation of the latter type, it might be urged theoretically that the opening of the chest added the collapse of one lung and possible additional shock to the burden which the patient has to bear. As a matter of fact, if the hernia can be reduced from an abdominal incision alone, the chest will be thereby opened, except in those few cases where there is a congenital hernia with a true sac, because the reduction of the hernia puts the chest cavity in communication with the outer air by way of the hernial defect and the abdominal incision. This is not a mere matter of assumption, but it has been proved by the writer experimentally on dogs, in whom defects in the diaphragm were made, following which there was an immediate inrush of air into the pleural cavity on the side opened. Therefore the objection noted above has no weight. The single remaining additional burden imposed on the patient by the combined operation is the trivial matter of an incision through the chest wall, perhaps with the removal of a piece of rib, which is quite unimportant compared with the advantages gained thereby.

It is not desired to give the impression that the combined approach is original. It has been accorded passing mention by Soresi² and others, usually with the implication that it may be employed as a last resort. The purpose of this article is to establish reasons why the simultaneous abdominal and thoracic attack should be considered the standard method of approach in the large majority of cases of diaphragmatic hernia.

SUMMARY

1. Abdominal exploration is essential in the great majority of cases of diaphragmatic hernia.
2. Thoracic approach greatly facilitates the necessary operative steps.
3. The method of choice, therefore, for the routine handling of these cases should be by combined abdominal and thoracic incisions.
4. These incisions are best made separately instead of by the French method of a continuous incision.

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PERFORATION IN UTERO OF A GASTRIC ULCER*

BY WALTER ESTELL LEE, M.D.

AND

J. RALSTON WELLS, M.D.

OF PHILADELPHIA, PA.

GASTRIC ulcer in children before the tenth year is unusual and warrants recording. The literature of the last thirty-five years contains a number of references to gastric ulcer in patients within the first decade of life. A complete summary of those which we have been able to find is as follows: Lockwood 125 cases, Covey 1 case, Skill 5 cases, Fenwick 18 cases, Parkinson

1 case, Welsh 1 case, making a total of 160 cases. During the first year of life there are eight cases recorded, one each by Rillet, Billard, Goodhart, Phelip and Fey, Cade, Lockwood and Roth.

In the group of cases of perforation in the newborn, we can find but two cases aside from

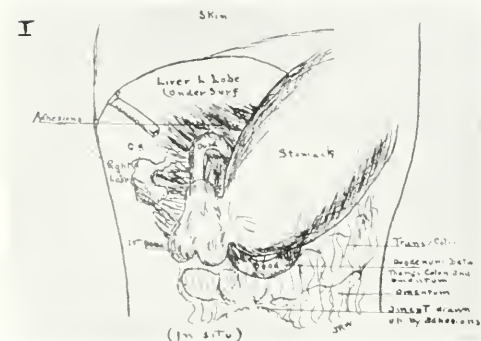


FIG. 1.—Showing organs adjacent to pylorus, bound together by adhesions.

the one to be reported. One of Bisset, in an infant forty-eight hours old, and one of Nuzum, who was twenty-four hours old. We are inclined to believe that these two cases do not fall into the class in which we have placed the present one, namely perforation *in utero*, because the two cases alluded to were apparently normal at birth and remained so until there were symptoms of an acute abdominal catastrophe, followed by melena neonatorum or vomitus or both. These symptoms were acute and death rapidly followed in about the time of sequence that the rupture of a hollow viscus usually takes.

Case Report.—The patient, a colored male infant, was born September 8, 1922, and admitted to Children's Hospital when ten days old. Though his twin brother had been perfectly normal (and has had no illnesses up to the time of reporting this case, January, 1923) our patient had exhibited symptoms of pyloric obstructions from birth. The mother had previously borne a normal boy and a

* Read before the Philadelphia Academy of Surgery, January 8, 1923.

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girl, who are now living, and has had one miscarriage. The birth of the twins presented no unusual difficulties.

From the very first the patient vomited immediately after taking fluid. This vomiting was at times projectile but usually regurgitant. The vomitus itself was "foamy" and of a greenish color. The parents reported several bowel movements consisting of yellow and green fecal matter. Urination had been normal. No history could be obtained of convulsions or any abdominal catastrophe as might be evidenced by acute abdominal pain and distention, nor could any history be obtained of bloody vomitus or melena.

Physical examination showed a small, fairly well nourished male negro baby ten days old. The skin was copper colored, dry and wrinkled as if from the loss of weight or fluid. The child presented the appearance of dehydration. The head, chest, genitalia and extremities were apparently normal. The abdomen showed folds of skin about the groins and had the appearance of dehydration. There was a small umbilical hernia. Liver and spleen not palpable. No rigidity or tenderness. It was not possible to demonstrate peristaltic gastric waves or palpate any mass in the right hypochondrium. Impression, pyloric stenosis or high duodenal obstruction.

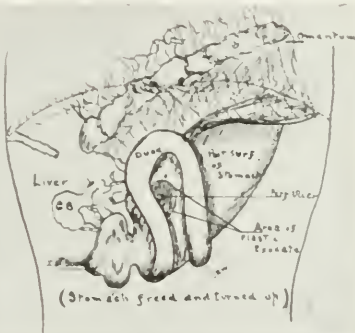


FIG. 2.—Showing opening in wall of stomach brought into view by separating adherent omentum.

Abstract of clinical notes previous to operation. While in the hospital the temperature range was erratic, from 96 to 100.4. The pulse varied from 100 to 144. Respirations from 28 to 52. There was apparently no relation between these variations. There were two bowel movements during the first four days in the hospital, both following enteroclysis. They were partly formed and dark green in color. On the day of operation there was a small yellow-green stool. He vomited from one to five times during each twenty-four hours before operation.

Patient was admitted to the medical service and was fed with mixtures composed of skim milk, farina and wine whey in various combinations. He lost weight steadily, falling from 4 pounds 9 ounces, to 4 pounds 4 ounces on the day of operation. Urine normal except for a faint trace of albumen and a few hyaline casts. Vomitus was acid in reaction and contained no bile or blood. The stomach contents after lavage contained bile.

Röntgenological report.—On September 21, 1922, he was given a barium meal. Six hours later no barium had passed into duodenum and after twenty-two hours only a very small portion had passed through the pylorus. Diagnosis.—A very definite obstruction at the pylorus.

Operation.—Under ether anesthesia the abdomen was opened through a right upper rectus incision 6 cm. long. The pylorus was found lying very deep in the hepatic fossa and it was exposed with difficulty. Adherent to the pylorus and to the greater curvature of the stomach there was a section of small intestine,

which upon separation of the adhesions, was found to be the distal portion of a very long duodenum. When these two long limbs of the U-shaped duodenum were finally separated the flexure or knee, corresponding to the second portion of the duodenum, was found to be adherent to the under surface of the liver and gall-bladder. These adhesions were strong, well organized and separated with difficulty owing to their density. They were practically avascular. Following the release of this duodenal obstruction the distal portion was seen to fill and distend with contents expressed from the stomach. The stomach was then more carefully examined and a circular constriction was found about 2 cm. from the pylorus which presented the appearance of an hour-glass contracture. The wound was closed by layer sutures and the child's condition was very satisfactory when he

left the operating room. He continued to do well post-operatively except for shallow breathing and lack of vitality. There was one stool subsequent to operation which contained yellow-green feces. There was no vomiting after operation until probably just before death, during the twelfth hour, when the nurse found the child moribund.

Autopsy.—Performed by enlarging the operative incision. Intra-abdominal palpation failed to reveal any abnormality except in the right upper quadrant. The entire region surrounding the pylorus was a mass of adhesions in which all the organs seemed bound together. These adhesions were very strong, dense and fibrous. There were no so-called fresh adhesions. Before cutting any of



FIG. 3.—Showing distinct hour-glass contracture and position of dense band of connective tissue.

these fibrous bands a survey revealed the pylorus and the hour-glass contraction pulled down, back and beneath the inferior surface of the right lobe of the liver. A small portion of the duodenum was seen protruding below the stomach in this region. Pressure upon the stomach showed that the operative mobilization had been complete in relieving the obstruction, for air could be freely forced from the stomach into the lower gut. Upon raising the left lobe of the liver the stomach and first portion of the duodenum were exposed more freely. Dense adhesions were found between the gall-bladder, the under surface of the liver, the duodenum and the stomach, and the posterior wall of the stomach was distinctly involved in these adhesions. Upon separating these and cutting several of the fibrous bands the posterior surface of the stomach was exposed.

The two limbs of the duodenal loop were firmly adherent to the posterior surface of the pyloric antrum. Between these two limbs and well down towards the greater curvature of the stomach, partially covered by the one nearest to the pylorus, was a dense patch of flat, yellowish oval shaped tissue measuring 2×2.5 cm. By accident the edge of this patch was raised and finding that it stripped easily from the stomach it was removed and a small perfectly rounded hole in the stomach wall was revealed. The peritoneal edges of this hole were inverted. There appeared to be no inflammatory reaction in the lesser peritoneal cavity

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in this region. Pressure on the stomach caused several bubbles to emerge from this perforation. A probe carefully inserted through the hole proved the lesion to be a complete perforation of the stomach wall, it measured several millimeters in diameter. A section of the stomach wall containing the perforation was removed and again the absence of active inflammation about this area was especially noted. The interior of the stomach failed to reveal any other lesions except a very dense mass of indurated tissue in the stomach wall at the site of the circular contraction of the pyloric antrum, but there was no ulceration seen in this area. The described perforation was approximately 4 cm. from the pylorus and was situated upon the posterior wall of the stomach near the greater curvature. There

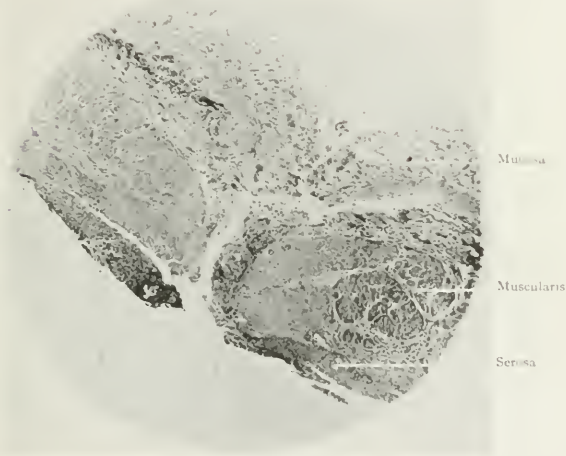


FIG. 4.—Low-power view of perforation.

were no evidences of peritonitis in the lesser or greater peritoneal cavities. There were no evidences of free blood in the stomach or intestines.

Microscopical Examination.—Section shows a strip of muscular and mucous membrane covered on one side by a split-up fibro-cellular zone upon which is a recent fibrino-purulent exudate. The muscular band is fairly well preserved although somewhat split by œdema. The submucous zone is distinctly hemorrhagic. Mucous membrane is hemorrhagic, lacking in fully formed tubules, while many epithelial cells are degenerated and absent from near the surface. The whole strand shows a defect or solution of continuity running from mucous surface to the exudate mentioned above as lying on the outer side. This defect is partly bridged over by a fibrinous exudate and by a piece of necrotic muscle; remnants of glands may be seen near it as if displaced from the mucous to the muscular layer. The edges of the mucosa proper at the point of defect are turned in somewhat but do not show distinct ulcerative-tissue reaction or marked round-cell infiltration. **Diagnosis.**—Rupture of a part of the intestinal tract, probably stomach, with fibro-purulent peritonitis.

Discussion.—Our case was apparently suffering from gastric or intestinal obstruction at the time of birth which became gradually worse until the tenth day of life. At the time of admission to the hospital all the symptoms of pyloric obstruction were present. Contrary to Holt's broad statement that the only symptom of gastric ulcer in children is hemorrhage, our case gave no symptoms of melena or bloody vomitus. In fact, there were no symptoms of gastric ulcer or perforation before operation nor was the diagnosis made at operation, so perfectly had nature taken care of the situation.

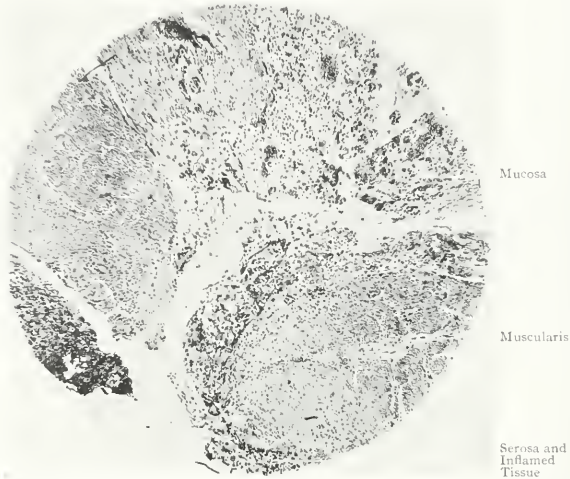


FIG. 5.—High-power of Fig. 4.

We submit the following reasons for our diagnosis of perforation *in utero*. (a) Unless an acute gastric ulcer occupies but a matter of a few hours from its start to perforation, we may safely assume that the two cases of Bisset and Nuzum developed their gastric ulcers *in utero*. Both of these cases were apparently normal for a number of hours after birth, when symptoms of an acute abdominal catastrophe were followed by peritonitis. These conditions were entirely absent in our case.

(b) Though intra-abdominal adhesions may form in a few hours under these conditions, they are friable, vascular and of the consistency of cobwebs. In our case the adhesions showed a degree of firmness and density and a vascularity that is seen in a stage far later than that of acute inflammation. The age of these bands was certainly several weeks antedating the child's birth. The cause of these adhesions, the perforated ulcer, antedated the adhesions.

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(c) When we consider that after birth the stomach and intestines are distended for the first time with food, is it not reasonable to think that if this perforation had occurred after birth such gastric contents escaping into the peritoneal cavity would have given acute signs of a general or at least a localized peritonitis? As our patient exhibited no signs even remotely suggestive of an acute inflammatory abdominal condition, nor any pathology of such a process, we feel that the effective plugging of the perforation by a mild chemical reaction of the gastric secretion took place before the stomach contents were infected. The stomach before birth is naturally sterile and contains slightly acid secretion and this could well have set up an acid irritation on the serous surfaces of the lesser peritoneal cavity sufficient to cause adhesions without having a bacterial infection.

(d) Many authorities on children's diseases believe that hemorrhage is a constant symptom of gastric ulcer in children. The control of bleeding from such an ulcer is, of course, by the process of thrombosis of the vessels. A close study of the microphotograph will show that several small vessels, surrounding this perforation and in the ulcer area, are filled with plugs of tissue which are probably connective tissue. Some time was required to reach this stage of organization. Again the piece of tissue inverted from the serous surface into the canal is not that of an acutely eroded surface but resembles chronic tissue.

(e) The definite hour-glass deformity of the stomach, with infiltration of the stomach wall, would seem to indicate a chronicity of the process which was longer than fifteen days preceding the operation.

(f) The fact that the barium meal given on the thirteenth day showed no leakage through the perforation into the lesser peritoneal cavity is evidence that the perforation was closed at this time.

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HEMANGIOMA OF THE INTESTINE

BY FRANK HELVESTINE, JR., M.D.

OF UNIVERSITY, VA.

FROM THE DEPARTMENT OF PATHOLOGY, UNIVERSITY OF VIRGINIA MEDICAL SCHOOL

HEMANGIOMAS of the cavernous type are of rare occurrence in the intestines, if one may judge from the small amount of literature on the subject. The majority of text-books on pathology mention the possibility of angiomas occurring in the intestine, but give no details. Ohkuba, whose two cases occurred in a group of less than a hundred consecutive necropsies, believes that the condition is present more frequently than is generally recognized. Among more than five hundred necropsies performed at the University of Virginia Hospital, one case of hæmangioma of the intestine has been observed.

CASE REPORT

Clinical History.—The patient, a female mulatto, seventy-two years old, entered the University of Virginia Hospital, November 4, 1916, suffering from a dislocated shoulder. The dislocation was reduced and the patient, who was feeble-minded, seemed to be doing fairly well. She had been suffering for some time before admission from shortness of breath and swelling of the ankles. Just before death she developed a cough. There had been no gastro-intestinal symptoms except a mild diarrhœa.

Necropsy. No. 239.—The body is that of a mulatto woman, 165 cm. in length, apparently normally developed and well nourished. There is œdema of the feet and ankles. The abdomen is not distended. Enlarged glands are palpable in the inguinal region, axillæ, and neck. The left lobe of the thyroid is enlarged. There is a small amount of serous fluid in the pleural cavity. The lungs are bound down by dense adhesions. On removal of the lungs a frothy fluid escapes from the bronchi. The heart is enlarged. The myocardium is thin and pale and there is sclerosis of all the valves. There is a small amount of serous fluid in the abdominal cavity. The liver and spleen are somewhat enlarged and they show the picture of chronic passive congestion. The kidneys show the changes of chronic nephritis.

Situated on the jejunum, 27 cm. from the pylorus, is a pedunculated mass, 5 x 4 x 4 cm. This tumor is attached to the external surface of the intestine near the mesenteric border. It has for the most part the color of venous blood, but scattered over it are numerous hard whitish areas. These resistant areas alternate with soft cystic regions of purple color. The peritoneal covering of the tumor is smooth and glistening. Upon opening the intestine it is seen that the mucous membrane is not involved. On gross section the tumor is found to be cystic. It contains a brownish fluid and a small amount of grumous material. The tumor is definitely encapsulated by a fibrous envelope which varies from 1 to 5 mm. in thickness. The thickened portions are white and tough while the thin portions are of the color of old blood. The central part of the tumor mass is spongy and irregular in structure. There are several large sinuses just under the capsule. (Fig. 1.)

Microscopic examination of a section of this tumor shows large, irregular, endothelial-lined spaces containing erythroplastids. These blood spaces are

HÆMANGIOMA OF THE INTESTINE

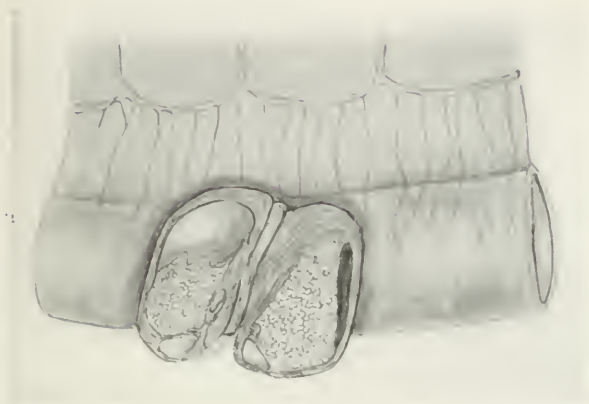


FIG. 1.—Drawing representing a portion of the jejunum including the hæmangioma. The tumor has been sectioned and spread apart to show the interior. The capsule is thick and fibrous. Immediately under the capsule are several various-sized smooth-walled sinuses. One of the sinuses in the half of the angioma to the right contains a thrombus. The central portion of the tumor is of a granular sponge-like structure.

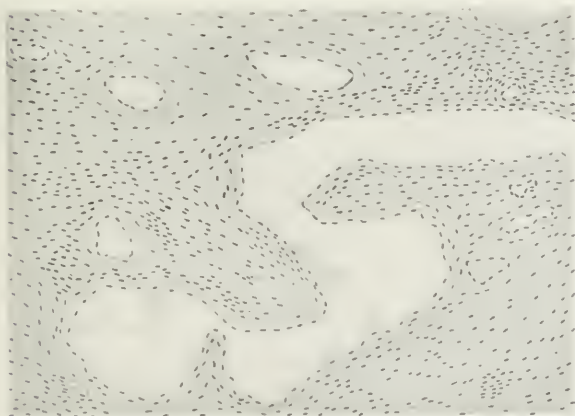


FIG. 2.—Drawing of microscopic section through a portion of the more fibrous part of the tumor. The area includes several large irregular spaces lined with endothelium and containing red blood-corpuscles. The stroma surrounding these blood spaces is composed of dense fibrous connective tissue.

separated from each other by a dense connective tissue stroma. The picture gives the impression of a cavernous hemangioma which is undergoing retrogression. (Fig. 2.)

The following is a brief summary of fourteen cases of hemangioma of the intestine appearing in literature:

Gascogen¹ records the case of a man, aged forty-four years, with numerous nevi in the serosa of the intestine.

Laboulbene² reports a case of erectile tumor of the duodenum which gave rise to fatal hemorrhage. The patient, a man aged sixty-four years, had suffered from slight constipation for several years. One morning he passed some blood at stool, and this was repeated for several days. One month later he vomited a large quantity of black coagulated blood, and again passed blood at stool. After a few days his condition again appeared normal. The case was regarded as one of duodenal ulcer. Several days later there occurred extensive hemorrhage from the bowel, following which the patient died. At necropsy the intestine was found to be filled with blood. In the duodenum above the papilla of Vater there was an elevated tumor about the size of an almond. This structure was covered by mucosa except for a ragged ulceration which laid bare the tumor tissue. The growth was composed of greatly dilated capillary spaces.

Boyer³ describes the case of a man, aged sixty-two years, who at necropsy showed numerous varices in the jejunum and upper part of the ileum. These were rounded blackish nodules which were visible by transmitted light. The largest nodules were the size of a pea, but the majority of them were much smaller. They were closely aggregated throughout the submucosa. No alteration of the large arteries or veins could be discerned, but when examined with a lens, these nodules appeared to be situated upon arterial loops, and to be themselves formed of vascular loops like a renal glomerulus. The nodules were fairly sharply outlined, and the walls of the capilliform vessels, which were twisted together to form the nodules, were parallel to each other and in continuity with the arterioles. Each nodule was surrounded by a connective tissue envelope.

Paci⁴ reports a case of a woman who had suffered for a short time with symptoms of intestinal obstruction. Suddenly she passed, along with feces, a mass of tissue which was recognized as a pedunculated cavernous tumor. The central portion of the tumor was composed of cavernous tissue, with large lacunae filled with clotted blood. Numerous capillaries occurred in the trabeculae, and the whole was covered with mucosa. Hemorrhage had occurred into the substance of the tumor, enlarging it to such an extent as to cause obstruction. Subsequently the tumor had been torn from its peduncle and passed from the bowel. Thus the obstruction was relieved at once.

Nicoll⁵ reports the case of a young woman, aged twenty-three years, who suffered from symptoms of acute intestinal obstruction. The patient had had a similar attack two weeks previously and during the fortnight she had had pain in the epigastrium, coming on shortly after meals, and lasting for about an hour. At operation a double intussusception, involving over five feet of bowel, was discovered. Unable to reduce the intussusception, Nicoll resected the intestine. Upon opening the involved bowel he found a tumor about the size of a pigeon's egg. The tumor consisted of large thin-walled spaces filled with coagulated blood and it was typically nevoid. It contained two small phleboliths, each the size of a split pea. One of its surfaces was covered with peritoneum, and the other, the internal surface, with villous mucous membrane.

Hektoen⁶ records a case of endocarditis in which there were many large veins under the intestinal mucosa resembling varicose veins. These vessels occasionally

anastomosed and overlapped. They occupied a limited portion of the small intestine, and sometimes presented globular dilatations filled with blood. Microscopically they proved to be dilated venules, and Hektoen speaks of the condition as a simple hæmangioma.

MacCallum⁷ describes the case of a white man, aged fifty-four years, who had had digestive disturbances for months. Two years prior to admission to the hospital the patient had vomited a quantity of blood. At necropsy the small intestine was normal throughout, as far as the mucosa was concerned; but throughout its length, especially in its upper portions, there could be palpated either from the peritoneal side or from the luminal side small fairly firm areas. These areas were visible through the mucosa as blackish purplish patches, the largest of which reached a diameter of 7 to 8 mm. By transmitted light they appeared as dark red, thick nodules situated along the course of the veins, and connected by abundant branches with the larger veins. Microscopic sections showed that these areas were vascular tumors of cavernous structure composed of wide sinus-like spaces lined by endothelium and filled with blood. The structures were entirely in the submucosa.

Bennecke⁸ reports the case of a man fifty-two years old, who died of tuberculous meningitis. In the small intestine were found many small brownish-red masses. These masses were moderately firm, irregular and covered with mucous membrane. They were situated entirely in the submucosa, and occurred in the stomach and œsophagus as well as in the small intestine. Microscopically these masses consisted of a communicating system of cavities partly filled with blood. This system of cavities was intimately connected with the neighboring vein.

Ohkuba⁹ reports two cases of intestinal angiomas. His first case occurred in a woman, sixty-six years old, who died of pneumonia. The wall of the entire intestine was pale and, with the exception of innumerable varices in the submucosa of the jejunum, showed no pathologic change. The second case occurred in a man, seventy-nine years old, who died with a terminal pneumonia. In the submucosa of the entire small intestine were numerous, scattered, pea-sized, varicose nodules. Ohkuba considers the lesions in these two cases the same. The nodules were situated in the submucosa and projected slightly into the lumen of the intestine. There was no change in the mucosa covering the nodules. Viewed by transmitted light the nodules appeared dark red in color, irregularly formed and attached to the vein. Under the microscope these structures were seen to be composed of irregular communicating cavities lined with endothelium. Ohkuba regards these nodules as true cavernous angioma.

Tuffier¹⁰ describes a case of angioma of the sigmoid in a man thirty-one years of age, which gave rise to fatal hemorrhage. Intestinal hemorrhages appeared at the age of seven years, associated with tenesmus and the passage of about a tumbler full of bright red blood. These hemorrhages continued at intervals of months or years until the patient's death. Rest in bed would usually relieve the patient and he would be able to resume his work. He became very anemic and his condition was considered to be one of pernicious anemia. When the patient came to Tuffier, the latter did a sigmoidoscopy and found situated, 22 cm. above the anus, a small purplish tumefaction about the size of a pea. This was slightly ulcerated. At the level of this mass were some little nodular areas which had the appearance of naevi. This ulcerated area was considered to be the site of the hemorrhage and was accordingly cauterized. The patient recovered to a certain extent, but later the hemorrhages recurred. A laparotomy was performed but no tumor discovered. The patient died and at necropsy, at the level of the flexure of the sigmoid, two small angiomas were discovered. These structures were small red masses about the size of a pea, and were situated in the submucosa. No ulceration was apparent.

Hartmann¹¹, in a discussion of Tuffier's paper, cited a case of angioma of the rectum which had occurred in his own practice. The patient, a woman twenty-two years old, had been referred to Hartmann for bleeding hemorrhoids. Blood in this case, however, preceded the stool, which is not the case in hemorrhoids. Proctoscopy revealed a small angioma. Cure followed electric cauterization of this tumor.

Dujarier and Topous Khan¹² record a case of a man who had been having rectal hemorrhages intermittently for three years. He has become very anemic and emaciated. An exploratory laparotomy revealed a number of cavernous angiomas of the sigmoid, associated with marked varicosities of the veins.

Judd and Rankin¹³ report a case of hæmangioma of the duodenum in a woman twenty-two years old, which caused chronic obstruction. The patient had had chronic dyspepsia since childhood. Any dietary indiscretion caused nausea and epigastric distress. Recently she had had severe abdominal pain. Röntgen-ray examination showed a shadow in the duodenum. At operation a thick walled dilated stomach was found, and in the duodenum was a rounded tumor completely filling the lumen. The tumor, which was 3 cm. in diameter, was excised. It proved to be a cavernous hæmangioma.

In the wall of the intestine there are three plexuses of blood-vessels: a subserous plexus, an intramuscular plexus, and a submucous plexus (Jordan¹⁴). Angioma may arise in any one of these plexuses. The submucous plexus is the most extensive, and it is in the submucosa that the majority of hæmangiomas occur. The case reported here is an example of an angioma arising in the subserosa; while the case of Nicoll, in which the angioma had a covering both of mucosa and serosa, might have had its origin in the intramuscular plexus.

Angiomas of the intestine may be divided into two classes: simple and cavernous. To the class of simple angiomas belong the cases of Gascoyen, Boyer and Hektoen. The cavernous angiomas may be either multiple or solitary. The four cases of multiple angiomas (MacCallum, Bennecke, and Ohkuba) are very similar. These lesions all occurred in individuals of advanced age. The tumors were situated for the most part in the jejunum and upper ileum, were of small size, and showed a definite relation to the veins of the submucosa. With the possible exception of the case reported by MacCallum these growths gave no symptoms.

In the majority of cases the tumor occurs in the small intestine, most frequently in the upper portion. Tuffier, Hartmann, and Dujarier and Topous Khan report cases of angiomas occurring in the sigmoid and rectum.

Hemorrhage occurred in four, or 28.6 per cent., of the fourteen cases I have been able to collect. In two of the cases the hemorrhage proved fatal. If the tumor is situated in the sigmoid or rectum, and is the seat of hemorrhage, the clinical picture may be confused with that produced by hemorrhage from hemorrhoids. If bleeding occurs from an angioma in the small intestine the clinical picture may simulate that of duodenal ulcer. There is a possibility that an angioma situated under the serosa might give rise to intra-abdominal hemorrhage.

The angiomas caused intestinal obstruction in three cases (21.4 per cent.). In two of these cases the symptoms were acute. In one case obstruction was due to the size of the tumor; in another case obstruction was due to intussusception caused by the tumor. The third case gave symptoms of chronic obstruction.

Hæmangiomas situated in the rectum or lower sigmoid may be successfully treated by cauterization. In the small intestine the angiomas, especially of the solitary type, are readily removed by excision. Judd and Rankin remark on the splendid results obtained by operative surgery in these cases.

SUMMARY

1. Hæmangiomas may occur in the intestinal submucosa, between the circular and longitudinal muscle layers, or under the serosa. The angiomas may be either simple or cavernous in type. The cavernous angiomas may be either solitary or multiple. Most angiomas arise in the submucosa.

2. Angiomas may give rise to intestinal or intra-abdominal hemorrhage, or to intestinal obstruction. Obstruction may be due to the size of the tumor or to intussusception. Hemorrhage from an angioma situated high up in the small intestine may be confused clinically with bleeding from a duodenal ulcer. Bleeding from an angioma of the sigmoid or rectum may simulate hemorrhoids.

3. These tumors may be either cauterized or excised with good results.

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FURTHER OBSERVATIONS ON A MODIFIED INGUINAL
HERNIOPLASTY TECHNIC, WITH COMPLETED
UTILIZATION OF THE APONEUROSIS
OF THE EXTERNAL OBLIQUE*

BY DEWITT STETTEN, M.D.

OF NEW YORK, N. Y.

IN 1920, under the title "Modified Technic for the Radical Cure of Inguinal Hernia in the Male,"¹ I reported on a modification of the Bassini-Andrews hernioplasty technic, the essential principle of which was the complete utilization, without mutilation or distortion, of all the useful, available structures for the actual repair of the hernial orifice, by the overlapping beneath the transplanted cord and over the Bassini suture line of the external oblique aponeurosis. Schley,² in a paper, which immediately followed mine, supported these suggestions by the recommendation of a very similar procedure, and in a discussion on hernia at the May 12, 1920, meeting of the New York Surgical Society,³ several of the speakers, notably Woolsey, advocated the principle involved and stated that they had been using methods based fundamentally upon the same idea.

It is not my present intention to describe again in detail the development of this modification or to reiterate the various technical points involved, but rather to give a brief summary of some of my observations and experiences since the publication of my former paper, and to consider and answer some of the objections that have been raised against the suggested technic. In certain particulars the views as first expressed have been slightly altered or modified, yet, notwithstanding the criticisms advanced, the conclusions today, I believe, only strengthen the contention originally made that the method insures the maximum guarantee against recurrence, offers the greatest possible factors of safety, and is especially applicable in direct, large indirect and recurrent herniæ, particularly in the more complicated varieties, in sliding herniæ, and in cases where the development of the internal oblique muscle and conjoined tendon is defective or where Poupart's ligament is thin or tears easily, as in elderly subjects, with old, truss-abused herniæ. It should here be observed that the results with this method do not seem to be noticeably influenced by the patient's age, and therefore, I cannot quite subscribe to a recent statement of Pool's⁴ that, owing to the frequency of recurrence, operation is not considered advisable in patients over fifty-five years of age unless there are strong indications.

Before approaching the more technical questions, I would like to say a few words in further support of local anæsthesia. The past three years have but confirmed my belief that, for the average hernia case, local anæsthesia

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with one-half per cent. novocain-suprarenin solution is the anæsthesia of choice. In addition to the usual Braun injection, I believe it advisable to complete the subcutaneous and subaponeurotic rhomboid from points above and below Poupart's and then to infiltrate the skin in the line of incision. This latter procedure will obviate the delay of waiting ten to fifteen minutes for the conduction anæsthesia to take effect. When the external oblique aponeurosis has been incised and the cord exposed, the direct nerve injection, as high up as possible, of the inguinal branch of the ilioinguinal, the hypogastric branch

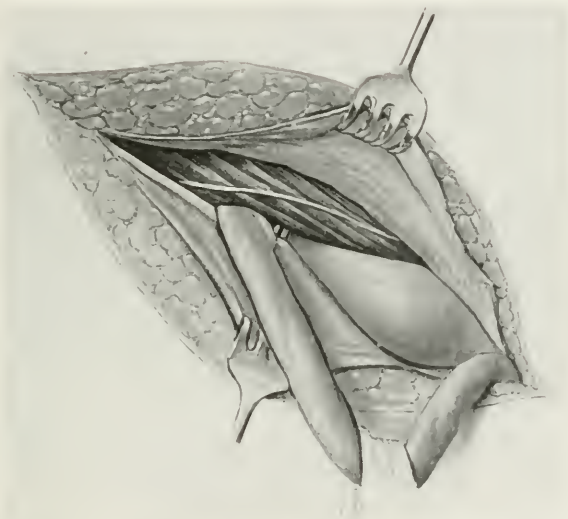


FIG. 1.—External oblique aponeurosis has been split. Large direct sac and small indirect sac are seen on either side of epigastric vessels.

of the iliohypogastric, if seen, and the genital branch of the genitocrural, is most helpful. This is further supplemented by a circular injection of the peritoneum at the neck of the sac, anesthetizing that region which is not affected by the usual injection. When an appendectomy is done in conjunction with a right-sided hernioplasty, a few whiffs of nitrous oxide may be useful during the locating, delivery and removal of the appendix. Aside from the diminished risk, there is no question but that the post-operative recovery as to pulmonary complications, vomiting, etc., is much less stormy after local anæsthesia, and the various objections offered, such as interference with primary union, increased tendency to recurrence, or femoral phlebitis, I have not noted. Serous accumulations or wound hæmatomata may be a trifle more

prevalent, but can be avoided by painstaking hæmostasis, not too close skin sutures, or temporary skin drainage in indicated instances. The fact that the patient is conscious and can cough to demonstrate the sac or to test the suture line is frequently most advantageous. It is true that the mental strain on the surgeon is greater when the patient is awake, but this is a purely subjective matter and is entirely overcome by sufficient schooling. The claim that local anæsthesia takes too much time and is more trouble to the surgeon is an indirect admission of its superiority.

Regarding the actual technical procedure, I wish to emphasize certain important points and to call attention to certain minor changes that have been

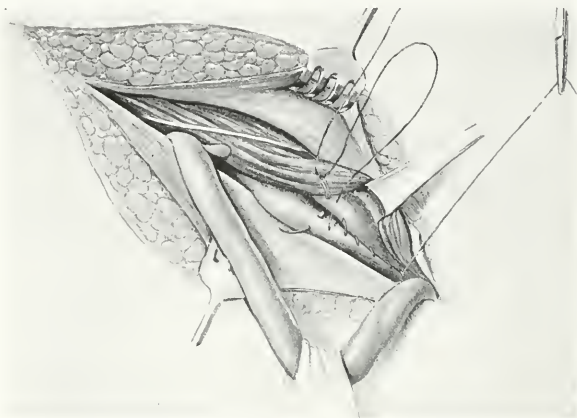


FIG. 2.—Direct sac with transversalis fascia covering is being inverted by continuous suture. Indirect sac has been dissected away and stripped from cord.

suggested by experience and adopted to simplify and to improve the operation. The vital feature of the modified technic is the use of the entire external oblique aponeurosis for the actual hernial repair, instead of for the ineffective, superfluous, and not infrequently injurious covering of the cord. It further insures a solid fascia to fascia union, and effectually dispels the common criticism of the inadequacy of the muscle to fascia suture line of the typical Bassini operation, although this may in a measure be overcome by catching as much as possible of the tendinous portion of the conjoined tendon. By the overlapping of the lower flap of the aponeurosis on the upper flap, assurance is made doubly sure by a second true fascia to fascia union. A preliminary removal of all the fat, covering muscle or aponeurosis, before the suturing is begun is extremely important to establish direct approximation.

The transplantation of the rectus muscle or of a flap from the anterior sheath of the rectus, I have found may be entirely dispensed with, even in the

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most unfavorable cases. In spite of the fact that many surgeons have recommended one or another of these plans to assist in the closure of large defects, they have always appeared to me as unphysiological and unanatomical distortions. The use of the external oblique aponeurosis in the manner advocated also does away with the need of a free fascial transplant which, even if it takes, becomes to a certain extent replaced by scar tissue and is in no way comparable



FIG. 3.—Inversion suture of direct sac with transversalis fascia covering has been completed and indirect sac has been pushed back. Medial angle of interrupted suture of internal oblique muscle and conjoint tendon to Poupart's ligament has been begun, with first or most medial suture including part of Gimbernat's ligament and second suture catching muscle and tendon flatly near edge.

to an attached, nourished and vital aponeurotic flap. As yet, orchidectomy has never been indicated in my experience with the method described.

In a direct hernia, if the sac is large, it is partially resected, but if small, it is merely replaced. In either case, a continuous No. 1 chromic catgut suture of the transversalis fascia covering the sac, beginning at the medial angle, is a most useful preliminary to the true hernioplasty, making really a quadruple, instead of a triple, suture line over the defect (Figs. 1 and 2). In many instances, especially in old herniæ, the transversalis fascia is distinctly thickened, and its suture alone holds back the protrusion and practically cures the hernia, as I have often demonstrated, by permitting the patient to cough or strain, before beginning the first true hernioplasty suture of the internal

oblique muscle and conjoined tendon to Poupart's. When the cord is drawn out, a small indirect sac is often found coëxistent with the direct hernia. This is usually an artifact due to the traction on the cord and it is merely dissected away from the cord, stripped and pushed back without opening the peritoneal cavity or, if large enough, it is ligated and resected (Figs. 1 and 2). If a typical indirect sac is found, transfixion, ligation and resection must be made as high up as possible, as it is now generally conceded that the proper disposition of the sac is most essential toward the permanent radical cure. The sac is only deliberately opened prior to its removal if it contains

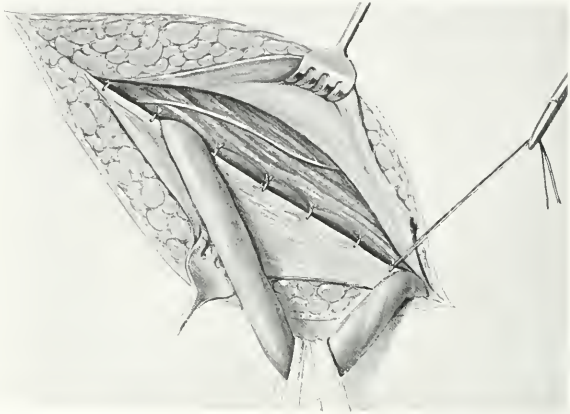


FIG. 4.—Interrupted suture of internal oblique muscle and conjoined tendon to Poupart's ligament has been completed. Edge of muscle and tendon are tucked under ligament. Two sutures, between which inguinal branch of ilioinguinal nerve emerges, are placed lateral to exit of cord. First or most medial suture is left long as guide for next suture layer.

irreducible contents or if, in a right-sided hernia, an appendectomy is to be done. If the ring is very large, the sac is resected and the peritoneal opening closed with a continuous No. 1 chromic catgut suture, which includes the transversalis fascia.

The method of suture has been slightly modified since the first publication. As already stated, a continuous No. 1 chromic catgut suture is used for the transversalis fascia suture, and for closing or inverting the direct sac. Then an interrupted No. 2 chromic catgut suture line is used for the Bassini suture of the internal oblique muscle and conjoined tendon to Poupart's. It is felt now that it is better to commence this suture at the medial angle of the wound and to work toward the internal ring. The skin incision should have been so made in the beginning that the medial angle of the deep wound is well exposed. The first suture should scrape the pubic bone and include part of Gimbernat's ligament (Fig. 3). It should be left long after it is tied as a guide

for the next suture line. The sutures, from four to six in number, should take a substantial bite but should penetrate the muscle and tendon flatly to avoid puncture of the intestine and may be tied as inserted. An effort should be made to insert them in such a way as to tuck the edge of the muscle and tendon beneath Poupart's. Two or three sutures are then placed lateral to the internal ring, beginning with the most lateral (Fig. 4). This method of placing the sutures permits of more discretion in the estimation of how

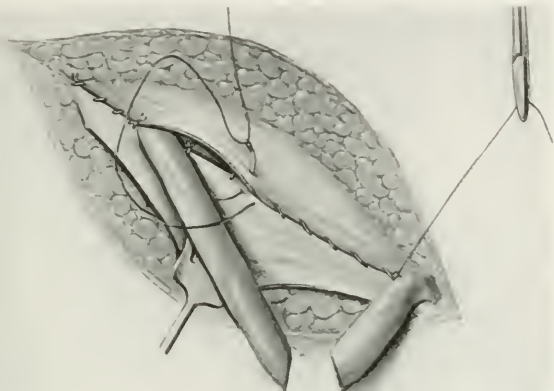


FIG. 4.—Continuation suture of upper flap of external oblique aponeurosis to Poupart's ligament beneath cord and over previous suture line. Suture lateral to cord has been begun at lateral angle and is completed. Suture medial to cord, having been begun at medial angle with end of suture left long as guide for next suture layer, is approaching exit of cord.

close they may approach the ring with impunity. The sutures should not be tied too tightly and the nerves should be retracted out of the way so as not to be included in the stitches.

In the suture of the upper flap of the aponeurosis to Poupart's, two short continuous sutures of No. 1 chromic catgut have been substituted for the interrupted suture, as making a more satisfactory approximation with fewer knots (Fig. 5). The first suture is begun at the lateral angle and runs inward to the ring, while the second suture begins at the medial angle at the spine of the pubis, with the uncut first Bassini suture as a guide, and runs outward to the ring. Two points in regard to both the internal oblique muscle-conjoined tendon and upper flap of the external oblique aponeurosis sutures to Poupart's should here be emphasized. Firstly, the needle entering Poupart's should vary its bite and pierce the ligament between different fibres so as to avoid tearing it. Care, of course, should be taken not to injure the femoral vessels. Secondly, an attempt should be made to displace the internal ring somewhat laterally, but without constriction of the cord. It is even possible

in most instances, especially in connection with the subsequent disposal of the lower flap, to arrange, with absolute safety, a valve-like action, from within the abdomen when the intra-abdominal pressure is increased, of the deviated, but not angulated cord, against the lateral end of the medial suture line (Fig. 6).

Having originally made a liberal lower flap of the external oblique aponeurosis to which damage from retraction has been carefully avoided, its division at a point opposite the exit of the cord, preparatory for its overlapping upon the upper flap beneath the cord, is the next step and a most important one. This should be done carefully, guarding the cord against injury, and the incision should be carried to, but not into, Poupart's ligament (Fig. 7). This division completely avoids kinking, compression, or strangulation of the cord, and I have gradually learned that, as a result of this procedure, one

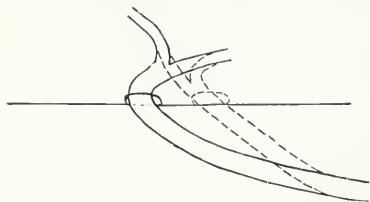


FIG. 6.—Diagram to show deviation of cord and lateral displacement of ring by two previous suture lines. Dotted line shows usual position of cord and ring, solid line shows deviation of cord and lateral displacement of ring.

can make a very snug suture around the point of exit of the cord without producing the slightest circulatory disturbance in the testicle. I am convinced that the tightness of the ring can be made considerably greater, and without any risk, than by any method where the cord is covered by the tough aponeurosis, and consequently angulated under a dense fascial layer or in

an unyielding fascial tube. This snug closure around the cord may be enhanced by cleaning the cord of lipomatous masses or useless cremasteric fibres, but care should be taken not to abuse or traumatize the cord, or disorganize and damage its important structures. The separation of the cord into two independent strands of vessels and vas deferens, to come out of separate rings, as has been recommended, I do not believe to be a very wise procedure. This disintegration may injure the vessels just enough to interfere with the testicular circulation.

The fascial division in no way weakens the repair, as the incision is through a point which ordinarily is not utilized for the hernioplasty at all, but merely as a cord covering. The objection that has been raised that the subcutaneous position of the cord is undesirable, can be answered merely by the statement that in my experience I have never yet observed the slightest discomfort or injury to the cord therefrom, and that in any operation for hernia a certain portion of the cord is always subcutaneous anyway, in a place where it is much more subject to trauma than on the aponeurosis, namely at its point of emergence from the external ring near the pubic spine. It has been suggested that damage to the cord because of its superficial position, might result during an operation for recurrence. Although, as yet, I have not had the opportunity to operate on a recurrent case in which this method

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had been used, injury to the cord can certainly be avoided if ordinary surgical caution is observed, especially if the type of the previous operation is known. Besides, the argument advanced is rather futile against the performing of an operation that seems most likely to prevent a recurrence and applies likewise in a measure to any other form of hernioplasty. The criticism that, in this operation, the so-called external and internal inguinal rings are superimposed, more or less, in the same anteroposterior plane and that therefore the opening is weaker, I consider purely theoretical, not based upon an understanding of the mechanics of hernia, and disproven by the results obtained.

In the final suture layer of the divided lower flap of the aponeurosis,

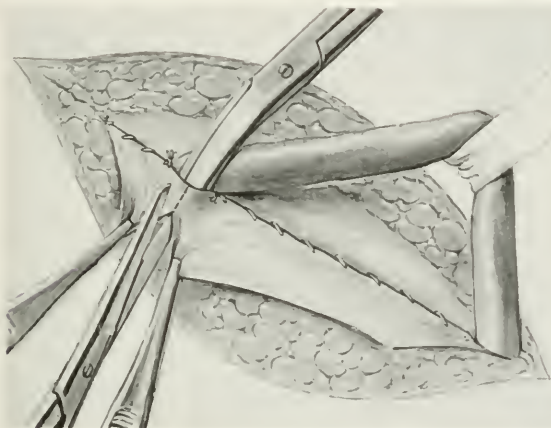


FIG. 7. Suture of upper flap of aponeurosis has been completed, lateral and medial to exit of cord. Splitting of lower flap of external oblique aponeurosis perpendicularly to its fibres at point opposite exit of cord which is guarded with blunt, curved scissors. Lower flap is divided into smaller lateral and larger medial portions.

overlapped upon the upper flap, again two short continuous sutures of No. 1 chromic catgut have been substituted for the previously used interrupted suture. The first runs from the angle at the point of division of the outer part of the flap to the lateral angle, and the second, from the angle at the point of division of the inner part of the flap to the medial angle. More of an attempt is now being made to bring the two portions of the divided flap together and to surround the exit of the cord as closely as possible, even overlapping them in suitable cases. Finally, two mattress sutures of No. 1 chromic catgut are placed near each free edge of the divided portions of the lower flap, fixing them on the upper flap of the aponeurosis, the lower mattress suture on either side coming close to Poupart's and including almost the free edge of the upper flap (Fig. 8). This manoeuvre establishes the most satisfactory ring, which, while tightly surrounding the cord exit, is still perfectly

safe. It will also be noted that in addition to the more extended use of the continuous suture, less heavy suture material has been adopted. This has been done because it is believed that the successful result of the operation depends not upon the character of the suture material or upon the type of the stitch itself, for which reason all obviously objectionable non-absorbable sutures and all complicated stitches are avoided, but upon the most satisfactory union of the tissues. Therefore, it is felt that the less irritation there exists from suture material, knots, etc., the better will this result be accomplished. I do not believe that a suture of the fat or superficial fascia

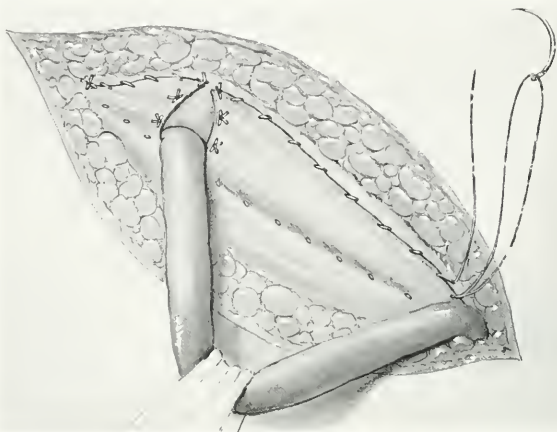


FIG. 8.—Overlapping and continuous suture of two portions of divided lower flap on upper flap of external oblique aponeurosis, with larger, medial portion beneath cord. Lateral portion has been sutured from angle at point of division to lateral angle. Suture of medial portion from angle at point of division to medial angle is just being completed. Two mattress sutures near each free edge of divided portions of lower flap to upper flap. Cord left subcutaneous.

is necessary, or even advisable, in most cases. It tends to enclose the secretions and predisposes to subcutaneous serous or sanguinous accumulations. In such cases where the testicle has been withdrawn from the scrotum during the operation, the superficial fascia and subcutaneous tissue is closed at the scrotal opening with a catgut suture or two in order to prevent the testicle from slipping out of the scrotum on to the abdomen during convalescence. I have once seen such an accident, which was fortunately recognized in time to replace the testicle, happen after an operation for varicocele. This disastrous complication can be further guarded against by leaving the scrotum out of the dressing where it may also be inspected and palpated. It should rest on a small cushion or on adhesive plaster bridge. The skin incision is closed usually by five interrupted silkworm gut sutures, with sufficient interval between them to allow some drainage of serum and blood. In cases where

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oozing is feared, as in operations for recurrent or large herniæ, a split rubber tube drain at one or both angles of the incision is used and withdrawn after two to three days.

In cases of femoral hernia the Lotheissen technic is followed through an inguinal incision. After splitting the external oblique aponeurosis, the sac is drawn into the inguinal canal. It is then transfixed, ligated and resected, or resected and sutured, or merely inverted with a continuous No. 1 chromic catgut suture which also includes the transversalis fascia, and the typical suture of the edge of the conjoined tendon to Cooper's ligament, covering the

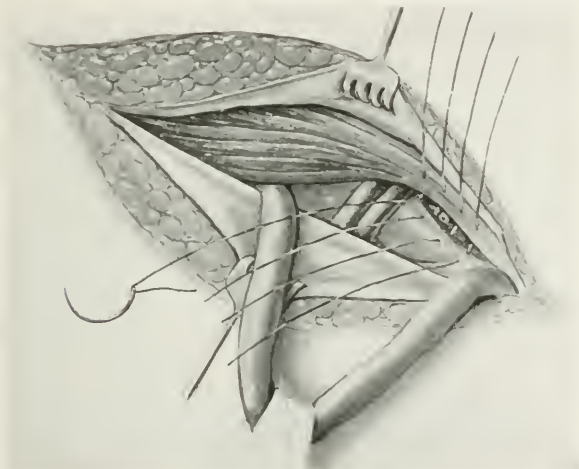


FIG. 9. -Femoral hernia sac has been ligated and resected through inguinal incision after splitting of external oblique aponeurosis. Interrupted sutures of conjoined tendon to Cooper's ligament in iliopectineal line have been inserted from medial angle to vein, with first or most medial suture catching edge of Gimbernat's ligament at its junction with Cooper's.

iliopectineal line, is made as close to the femoral vein as can be safely done, even angulating it a trifle (Fig. 9). Again, one begins at the medial angle, using interrupted No. 2 chromic catgut. The first suture catches the edge of Gimbernat's ligament at its junction with Cooper's. In this case, it is better not to tie the sutures, of which three or four are needed, until all are placed, as otherwise one has difficulty in placing the most lateral suture next to the vein and one may injure the vessel with the needle when inserting same for this last suture. Of course, if there is a typical inguinal hernia in addition, one must continue with the repair of the inguinal canal, but I have always had the feeling that, even if there is no obvious inguinal hernia, this operation, which I believe to be the best for the closure of the femoral canal, leaves a rather weak internal inguinal ring and a predisposition to the develop-

ment of inguinal hernia. Therefore, in every case, with or without an actually developed inguinal hernia, I proceed with a typical inguinal hernioplasty in the manner described above, except that the sutures in the medial half of the first, or Bassini suture line, instead of entering at or near the edge of the internal oblique muscle and conjoined tendon, which has been used for the Lotheissen suture, catches the muscle and tendon about one cm. above the edge and is tied over the Lotheissen suture line (Figs. 10 and 11). This can usually be easily done without the slightest tension. After the inguinal hernioplasty is completed, if possible, a few extra, interrupted No. 2 chromic catgut sutures are placed between Poupart's and the pectineal fascia as in the

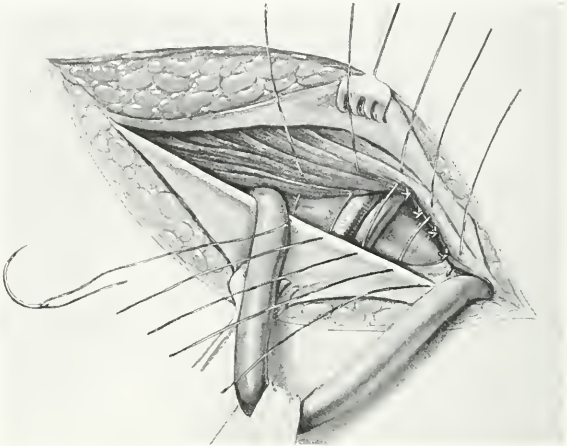


FIG. 10.—Sutures of conjoined tendon to Cooper's ligament have been tied and interrupted sutures of internal oblique muscle and conjoined tendon to Poupart's ligament have been inserted from medial angle to exit of cord as in typical inguinal hernioplasty, except that medial sutures grasp muscle and tendon somewhat above edge.

Bassini femoral hernia operation, to further insure the closure of the femoral canal (Fig. 11).

Very few changes in the after-treatment have been adopted. The bowels are left alone for three or four days, sometimes longer. I do not believe that gas pains are relieved by enemata or colon irrigations. I feel that it is better to handle the tissues gently during the operation and then to leave the parietic intestine alone and permit it to recover its tone without interference. Besides, straining at stool twenty-four or forty-eight hours after the hernioplasty cannot possibly be beneficial to the suture line. A modified Gatch bed is now used to relax the abdominal muscles by slightly sitting up the patient and flexing the thighs for at least a week after the operation, as Lyle⁶ has recommended. I have increased somewhat the duration of the patient's stay

in bed, as I believe that too early getting up tends to recurrence. Even in an uncomplicated, unilateral, indirect hernia, I rarely permit the patient out of bed before two weeks, and in complicated, large or bilateral hernie, I keep him in bed anywhere from sixteen days to three weeks. This is quite in accordance with the idea that complete cicatrization, as shown by experimental investigation, takes fully twenty-one days. Hard physical labor or active exercise should not be resumed for at least four to six weeks after the patient

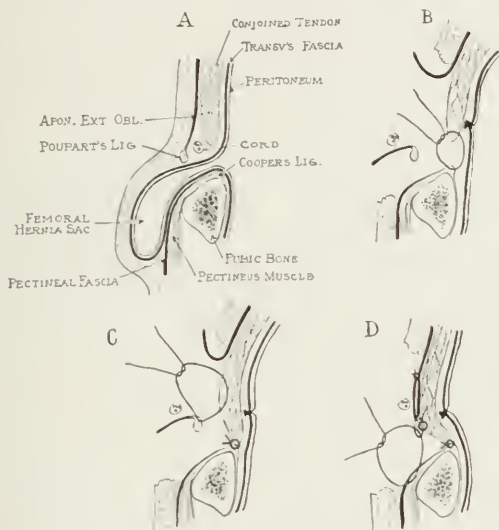


FIG. 11.—Diagram to show relations in combined femoral and inguinal hernioplasty. A. Shows cross section of anatomical relations in femoral hernia. B. Shows placing of suture of edge of conjoint tendon to Cooper's ligament. C. Shows suture of edge of conjoint tendon to Cooper's ligament tied and placing of suture of internal oblique muscle and conjoint tendon to Poupert's ligament somewhat above edge of muscle and tendon. D. Shows two previous sutures tied, upper flap of external oblique aponeurosis sutured to Poupert's ligament, lower flap of external oblique aponeurosis overlapped and sutured on upper flap, and placing of suture of Poupert's ligament to pectineal fascia. Cord subcutaneous.

has left his bed. A suspensory bandage may be worn for a month or two after operation, but under no circumstances should a truss of any sort be applied.

I regret that I am in no position, at the present writing, to give any hard and fast statistics in regard to recurrence. Up to the time of my first paper, I had personally done about two hundred cases by this method, and had not seen any recurrence in any of these cases which I had been able to follow up. A good many of them, it is true, were army patients, of which I had lost track. Possibly some of these have since been reoperated upon by other

surgeons, but no recurrences from this group have as yet come to my knowledge. In the past three years I have added ninety-three cases, of almost every degree and variety and in patients of all ages, to my personal list, some of which, to be sure, are quite recent. I have been able to trace practically all of the cases in this second series. Up to date I have found, among them, two recurrences. One was in a most unruly and restless patient, fifty-five years of age, with a very large direct hernia. On the evening of his operation, he demanded and, through some misunderstanding on the part of the house surgeon and nurse, received an enema. Apparently, there was no trouble because of this unfortunate incident, but a few months after he left the hospital, a definite recurrence was noted, which, I believe, was produced by the patient's restlessness in bed and the premature enema. The second was in a man, fifty-six years old, with a relatively simple indirect hernia, with no very large sac or ring. The patient made an absolutely uneventful convalescence, the wound healed by perfect primary union, and I am entirely at a loss to account for the recurrence, which developed fifteen months after the operation. As yet, neither patient has consented to reoperation, so that I am unable to present the anatomical findings or even to attempt an explanation of the mechanism in recurrence after the operation described.

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INTRACERVICAL ENUCLEATION

BY FRANK H. LAHEY, M.D.

OF BOSTON, MASS.

ATTENTION is directed to this method of intracervical enucleation, for removal of the cervix in hysterectomy for benign lesions, because in our hands it has proven such a rapid, safe and satisfactory measure for the accomplishment of this purpose.

It consists in the routine supracervical hysterectomy as done, for example, for fibroid uterus up to the point of section of the cervix. At this point, the cervix is not cut across or even removed by wedge-shaped excision, but is cored out by vertical circular incisions placed just within the outermost boundary of the cervix. The cervix is pulled up with each circular incision, until as the last incision reaches the vagina the thin remaining shell of cervical tissue is inverted from below upward, to drop back as the last circular incision separates the cervical plug from its shell of remaining cervical tissue. This leaves an opening through which a small strip may be tucked into the vagina to prevent the possible return of infected vaginal contents.

The stumps of the round, and if need be, the broad ligament, fit easily into the large aperture and may be sutured securely there. It has usually been necessary, in our experience, to place a large mattress stitch through the entire cervical shell, as shown in Figure 2, to control the oozing which occurs from the walls of the remaining cervical shell. It has once or twice been necessary also post-operatively to place a small piece of iodoform gauze in the vagina against the cervix for oozing, but in none of the cases has persistent oozing occurred.

We have made use of this method of getting rid of the cervix in hysterectomy for benign lesions to overcome the post-operative leucorrhœa and endocervicitis without producing in patients within the active sex age the vaginal shortening which results from the employment of complete hysterectomy for these lesions.

The disadvantages, as we have seen them, have been first the excessive oozing from the cervix during the process of coring, resulting often in a pooling of blood at the bottom of the pelvis and producing a somewhat messy condition at this stage of the procedure. This we have in some measure overcome by folding a towel into a triangular shape and introducing the apex into the fossa of Douglas so that any ooze is caught in the hollow of the towel so placed. This oozing has been immediately controlled as soon as the ligaments have been introduced into the large opening in the cervical shell and the cervical mattress suture introduced and tied.

It has been our experience that the additional step of cervix coring has added perhaps a few minutes more to the time of the operation. This additional time is less in our hands, however, than that required to perform a complete hysterectomy for a benign lesion of the uterus.



FIG. 1.—Showing the method of coring the cervix by circular incisions just within the outermost boundaries of the cervical wall. The cervix is dragged up as each circular incision frees it from the remaining wall, until not a wedge but practically the entire cervix is removed. Note the lateral traction made by the double hooks to accomplish exposure for the next circular incision.

INTRACERVICAL ENUCLEATION

Because of the fact that a thin shell of the cervix, even though it be only the junction of cervix with vaginal mucosa, is left, the occurrence of carcinoma in the remaining cervical stump is a possibility with this technic as well as in the routine supracervical hysterectomy, where it is by no means rare. However, even with this possibility in mind, we do not feel that complete

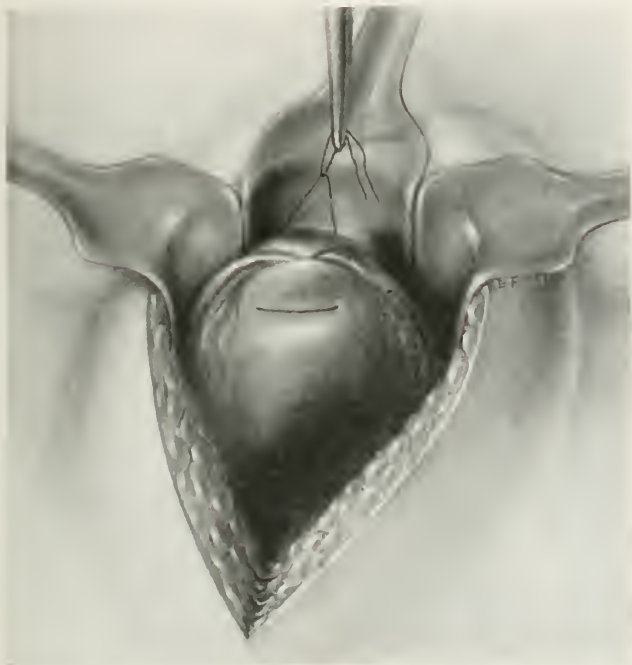


FIG. 2.—Showing the introduction into the cervix of the mattress stitch to control cervical oozing. Before this stitch can be introduced the bladder must be wiped down from the anterior face of the cervix. Approximation stitches are, of course, also introduced to close the cervical aperture and to fix the implanted ligaments in place.

hysterectomy in preference to hysterectomy by this technic is more indicated in a benign uterine fundus lesion than is complete hysterectomy upon a normal uterus to prevent the possibility of the occurrence of carcinoma.

The advantages have been that all of the cervix and cervical canal can be removed during active sex life with little or no shortening of the vagina, with but little time added to the operation, without danger to the ureters, and that excellent support can be obtained by the fixation of the round and broad ligaments as deeply as desired in the remaining cervical aperture.

FIG. 3a.



FIG. 3b.



FIG. 4a.



FIG. 4b.



FIGS. 3a 3b, 4a and 4b.—Showing photographs of two uteri opened and unopened to show the practically complete removal (except for remaining shell) of the cervix by this method.

SURGERY OF THE ECTOPIC KIDNEY

BY JOHN R. CAULK, M.D.

OF ST. LOUIS, MO.

IN order to direct attention to some of the interesting phases of this somewhat rare condition, six cases are herewith reported and discussed:

Case Reports.—CASE I.—H. M., age sixteen, brought in as an emergency, April, 1919, complaining of pain in her left lower quadrant, burning on urination. Family and personal history negative. Present illness started two days before admission with sharp shooting pains in the left side between the lumbar region and the left lower quadrant. Pains sharp in character, but did not radiate. Patient had vomitted frequently and had had chills and high fever. Associated with this, there was considerable vesical disturbance, such as frequency and burning on urination. She had been diagnosed, by an outside physician, as having an appendix abscess and was sent to the hospital for this condition.

On examination there was a tender mass in the left side, low down, with considerable spasm over this neighborhood as well as toward the mid-line. Leucocyte count 16,000. There was no tenderness over the right side in the region of the appendix. Catheterization obtained very dirty urine from the bladder, containing pus and colon bacilli, no red blood cells. The following day she was cystoscoped and her bladder showed a generalized cystitis, but nothing else of importance. Catheters passed into both ureters. Considerable retention of cloudy urine came from the left. Complete X-rays were taken with catheters in place. (Fig. 1.) The right catheter went to the kidney in its normal position. The left crossed the mid-line, curved upward opposite the lower part of the fourth lumbar vertebra and made a twist over the promontory of the sacrum. Right kidney was found normal. Function excellent. Function of the left kidney fair. Left catheter retained for drainage. Pyelogram at a later date showed marked hydronephrosis. Patient showed immediate improvement, temperature dropped to normal the next day. The left kidney was repeatedly drained by ureteral catheterization and lavaged. Patient showed remarkable improvement although the function of this kidney remained always inefficient and the urine never free of infection. A nephrectomy was advised but refused. There were no other congenital defects demonstrable. Diagnosis.—Left ectopic kidney and infected hydronephrosis.

She was re-admitted three months later with a recurrence of the pain in her side, after having fallen from a table. She was again drained with the same findings as on her previous admission. Again she refused operation. I have been unable to trace her since this time.

CASE II.—Man aged forty, mechanic, presented himself November, 1921, complaining of aching pain in lower left side and back. Past history, typhoid fever in young adult life, as well as recurrent chills and fever, however, no chills for several years until two months before admission. He began at first to have a dull pain in left lower back radiating down the left side over the bladder. This pain was never sharp, but aching and sickening, lasted several days then stopped. There had been some difficulty on urination. Would notice that his stream would stop and start. The pain in his side, he said, was always more severe when bladder was full, but was not relieved by urination. There was slight frequency, but no urgency or hematuria. For the last three weeks has had a continuous pain in this region. He lost weight and felt languid.

Examination.—He was a large healthy looking individual. Genitals well developed and normal, no congenital anomalies. Pulse and blood-pressure normal.

There was tenderness and spasm in the left side, just within the anterior superior spine. There was definite tender mass in this region running over to the mid-line. Pressure on this produced pain and also a desire to urinate. Another interesting fact in the examination was that there was some tenderness in the left kidney region. Urine was cloudy and infected with colon bacillus.

Cystoscopic examination showed a normal bladder. Catheters passed up each ureter the usual distance. From the left catheter came free dripping and several ounces turbid urine were immediately aspirated. Urine from the right side was clear.



FIG. 1.—Showing catheter curled over promontory.

The X-rays taken with catheters in position, showed the catheter going to right kidney which was normally posed, but the left catheter crossed to the right opposite the middle and upper third of the sacrum, curling upward, making a large circle above the promontory of the sacrum. It then twisted downward upon itself. Pyelogram taken at a later date showed large hydronephrosis. The function of this left kidney was practically destroyed and the right kidney was doing a great deal more than its normal work.

In neither of these cases was there an impression that the catheter had not gone to position for the normal kidney and it is easy to see that, had not an X-ray been taken with the catheters in place, or a pyelogram been done, a lumbar incision would have been made, which would have failed to disclose the kidney. The low position demanded a lower abdominal incision.

Nephrectomy was advised and accepted and on November 26, the kidney was removed through a left simular line incision, low down by the extra-peritoneal route. After opening the abdominal wall, the peritoneum was reflected inward, exposing a firmly fixed lobulated mass, tensely fluctuant and lightly adherent to the surrounding structures, resting upon the bifurcation of the aorta. The junction of this vessel with the iliacs was imprinted on its posterior surface as was found after removal. The vertical incision gave poor exposure and a trans-

SURGERY OF THE ECTOPIC KIDNEY

verse incision was made through the abdominal muscles and fascia for about two inches toward the mid-line. This gave a perfect exposure and allowed freedom of manipulation. The vessels came from the left side of the aorta as well as from some of the deep pelvic arteries. The ureter was short and very taut and entered the anterior aspect of the kidney into a markedly dilated pelvis. There was not the slightest trace of perirenal fat. There were adhesions to the bladder, as well as to the vessels posteriorly. The mass was easily removed. There was practically no oozing. Wound was closed as usual, cigarette drains placed into the space from which the kidney was taken. Patient made an uneventful recovery and left the hospital in sixteen days.

CASE III.—Mrs. M., age seventy, seen at St. Luke's Hospital, complained of frequent urination. Had always been healthy. She had no previous trouble of any sort. Had given birth to three normal children.

Two months before admission began to have frequency of urination, getting up at night six or eight times, and passing urine every hour during the day. With this there was an annoying low backache. There had been no history of renal colic, indeed there had been no other symptoms except those above described.

Examination.—Patient was wonderfully preserved. There were no congenital defects noted. There was some tenderness in the lower lumbar region on the right side and over the right iliac crest. Urine was cloudy, due to pus and colon bacilli.

Cystoscopic examination showed mild cystitis. Ureteral orifices were both normal. Catheter passed with ease to both kidneys. On the right side there was at least 4 ounces of retention within the kidney pelvis. X-rays taken with catheters in place showed the right catheter curled up low down on the right side over the sacro-iliac synchondrosis and extending up beyond the fifth vertebra. Left catheter went to the position of the normal kidney. Function of the two kidneys was similar and normal.

Diagnosis.—Ectopic kidney, right, infected hydronephrosis.

This patient has been treated for several months by ureter catheter drainage and lavage and is almost entirely relieved of her symptoms.

CASE IV.—Mrs. R. E. M., seen at the Barnes Hospital, complaining of frequent painful urination, hematuria, dull pain in the left side. Patient noticed first trouble about eight years ago, when a slight frequency and burning on urination set in. About this time the pain in the left side became perceptible. This attack lasted for three weeks. She was then comfortable for two years. Since this time she has had more or less bladder distress. There have been five attacks of pain in the lower left lumbar region, pelvis and supra-pubic region. Her last attack was in January of this year. For the last few months patient has had fever, occasional chills, noticed tenderness in the left side over the crest of the ilium and a mass. She has become weak and pale and very short of breath.

Examination.—Patient is very sallow. Shows marked anemia, about 40 per cent. hemoglobin, red cells in proportion, blood pressure 100 systolic. In February, following transfusion, her red blood count was 4,820,000. Blood pressure 120/75. There was a large mass filling the left flank running anteriorly over the crest of the ilium, tender, considerable infiltration of the tissues over the mass. Abdominal examination otherwise negative. Patient's heart and lungs were in good condition.

Cystoscopic examination showed a contracted bladder, the urine however was grossly clear. Bladder mucous membrane was thickened. There were two typical tuberculous ulcers, one on the base back of each ureteral orifice. The right ureteral orifice looked normal. The left markedly retracted, scarred, typical golf hole orifice. It was impossible to pass catheter up the left ureter. The catheter passed

up right ureter easily to kidney and got normal urine. The phthalein from the right side was equal to the total functional output, this coupled with clear urine gave the diagnosis of occluded renal tuberculosis with perinephritic abscess.

On February 7, 1923, the perinephritic abscess was drained, there being an enormous amount of pus evacuated. In feeling around during the drainage, it was found that the kidney was not in its normal position, but down in the lower part of the abscess cavity. Patient was drained, stood the operation well, received considerable relief from her previous absorption and toxemia. During the next few weeks she was given blood transfusions and three weeks later nephrectomy

was done. The kidney was found to occupy position just above the promontory of the sacrum.

The incision of the previous operation was enlarged downward in order to get exposure. This was on the 28th of February. The blood supply came from the lower part of the aorta, the exact location of which it was impossible to tell. The ureter was short and taut. The kidney was slightly larger than normal with a fair sized abscess cavity at the upper pole with marked adhesions between this and surrounding tissue. The rest of the kidney was



FIG. 2.—Both pelves on one side. Low down.

free. There was no perirenal fat around the kidney, it being bare. After the kidney was removed, I noticed that in the upper part of the incision, the perirenal fat seemed normal and in this fat was the adrenal body. Patient made a rapid recovery.

We were unable to diagnose this ectopic kidney during life on account of the inability to get a catheter or fluid up the ureter. Occasionally the shortening of a tuberculous ureter will pull down a kidney, but it would be impossible for the ureter to pull a kidney, normally placed, down to such a position. Furthermore this kidney was void of perirenal fat, the fat being in its normal position.

Diagnosis.—Occluded renal tuberculosis, ectopic kidney.

CASE V.—The fifth case is of a different type, being a congenital fused unilateral ectopic kidney, situated on the right side. Patient, age twenty-two, came to the hospital complaining of being practically bedridden on account of bearing-down pains in the lower abdomen and constant desire to urinate. She had suffered for several years and had been practically an invalid for the last two.

She urinated every few minutes without pain. There were no chills or fever. Her general condition was good, but she could not stand without feeling that "the

SURGERY OF THE ECTOPIC KIDNEY

whole of her stomach was dropping out of her," as she described it. There was a large mass occupying her right side running up over her iliac crest into the lumbar region, reaching to the mid-line and down into the pelvis. This mass was not particularly tender, but very firm and quite fixed. Cystoscopic examination showed a normal bladder except there was a bulging on the right lateral wall as though something from without was pressing inward. Ureteral catheters passed easily the usual distance and normal urine was obtained from both sides. Phenolsulphonphthalein test right and left appeared in 2 minutes. Right catheter recovered 20 per cent. in 30 minutes, left 22 per cent. X-ray with catheters in place showed the one on the right side going up toward the normal kidney



FIG. 3.—Case V. Unilateral unilateral fused kidney. U, ureter; B, bladder; A, artery.

region, but stopping about in the mid-lumbar region. Left catheter passed up to about the second sacral vertebra, then passed over to the right side and stopped about the promontory of the sacrum. There was no kidney shadow on the left side. Pyelogram showed two bizarre pelvises on the right. (Fig. 2.) The right one above and the left one below and internal. No abnormal ureteral openings. The diagnosis of ectopic unilateral fused kidney was made.

The patient insisted that something be done to relieve her of her suffering, and, while we did not feel that there was much hope, an exploratory operation was done on January 26, 1914. A large right-sided incision, extending from above the crest downward toward the mid-line, was made, and an enormous mass was exposed, consisting of two definite parts which were completely fused, the connecting bridge being composed of renal tissue. The outer part was an elongated mass 9½ inches long, had extended from well up in the lumbar region down into the pelvis as far as the hand could reach. Joining this rather symmetrically shaped mass and completely fused with it was a more or less lobulated mass on its inner side which was

shorter and broader than the outer part. Neither had a definite kidney shape. The transverse diameter of the whole mass was $5\frac{1}{2}$ inches. There were two large definite groups of vessels coming in across the inner lobule, one joining the elongated part at its upper extremity, the other entering the middle of the inner part, both of these came from the aorta. At the lower pole of this long outer mass were several very large vessels coming in from the deep pelvic vessels, just which ones could not be determined. The whole mass was so enormous and so fixed it was difficult to free. However, after freeing the mass as far as possible from above, the taut vessels from the pelvis were ligated and the kidney lifted at least one

and one-half inches.

It was then fixed to the lumbar muscles and fascia by numerous Broedel stitches, and partially decapsulated in places in order to create adhesions. Wound was closed as usual. Patient stood the operation well and left the hospital in 32 days. She was considerably relieved of her bladder trouble at this time. The last I saw of her was January, 1917, when she stated that she had felt considerably relieved. She was still troubled with her bladder, urinating at least every two hours, but the bearing-down pain in her lower abdomen, while present to some degree, had been materially benefited. The result was far better than had been anticipated. The examination showed the kidney to occupy

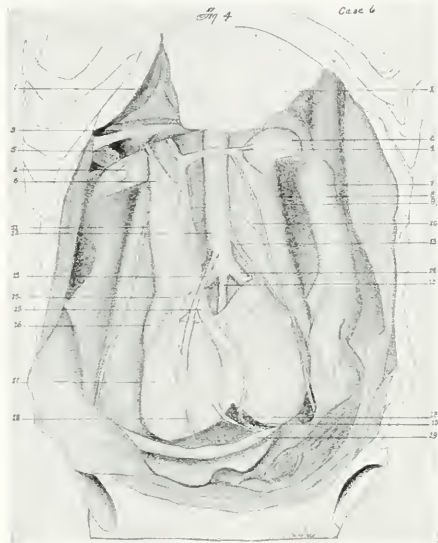


FIG. 4.—Fused pelvic kidney, negro male of 44 years. (L. L. Robertson del.) 1, liver; 2, suprarenal glands; 3, lig. teres hepatis; 4, left suprarenal vein; 5, gall-bladder; 6, inferior vena cava; 7, descending colon; 8, left internal spermatic vein; 9, psoas muscle; 10, left internal spermatic artery; 11, right internal spermatic vein; 12, aorta; 13, aberrant renal arteries; 14, left common iliac artery; 15, aberrant renal veins; 16, right common iliac vein; 17, fused pelvic kidney; 18, ureters; 19, peritoneal shelf.

the whole right side to the rib margin below the anterior superior spine. General health excellent. She was warned against a pregnancy, and has not been seen since. I can find no other citation of fixation of a unilateral fused kidney.

CASE VI.—This case is an anatomical report of a very remarkable kidney which was encountered in the Anatomical Laboratory of the Washington University Medical School, and it is through the kindness of Dr. Robert Terry, Professor of Anatomy, and Mr. L. L. Robertson, one of the students who found it during the dissection of a subject, that I have the privilege of presenting this interesting kidney condition.

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The kidney was centrally located, down in the pelvis below the promontory. There was complete fusion of the two poles, the left section being larger than the right. The measurements of this fused organ were 12.8 cm. in length, $11\frac{2}{3}$ cm. in width, and 3 cm. in thickness. The point of union between the two kidneys was composed of kidney tissue as is usually the case. The pelves were deficient and lacked their usual support of enveloping renal tissue. The two ureters were shorter than normal, slightly coiled, the one on the left entered the kidney near the middle of its inner border at its junction with the slight depression at the isthmus. The other entered the lower anterior aspect of the right side. Blood supply was quite anomalous. There were three renal arteries and only one on the right side of the fused kidney entered the hilus. Two of the renal arteries came off of the aorta about 1.2 cm. above the termination of the aorta into the two common iliac arteries. The extra renal artery came off of the aorta at its termination making it appear as a trifurcation of the aorta instead of a bifurcation. Since there was no middle sacral artery, this renal artery may probably be an enlargement of the middle sacral changing its function to that of supplying the kidney. The internal spermatic artery on the right side passed under the inferior vena cava. The renal veins emptied into the inferior vena cava slightly above where it receives the two common iliac veins. Both renal veins passed from the hiluses. The left suprarenal vein emptied into the inferior vena cava at the normal place for the renal vein. It received as a tributary the internal spermatic vein from the left side. The one on the right side emptied into the inferior vena cava at the usual place.

The kidney was bare and not surrounded by any perirenal fat, kidney being held in position by its pedicle, pelvic fascias and peritoneum. The peritoneum at its inferior border formed a shelf-like structure which supported it from dropping any lower.

The suprarenal glands were in their normal location in the epigastric region at about the level of the eleventh thoracic vertebra, the posterior surface resting against the lumbar area of the diaphragm, even though the kidneys were not in position. Also the adipose tissue of lemon color, which is peculiar to the kidney, was found along with the suprarenal glands in the epigastric region. The blood supply to the suprarenal glands was entirely from the inferior phrenic artery.

CONCLUSION

- (1) A fused kidney of this type is extremely rare.
- (2) The fusion was of renal tissue.
- (3) The renal pelvis varied markedly in size and shape, the ureters being somewhat short.
- (4) The blood supply of this kidney was plentiful, due to the fact that it still retained its embryonic circulation.
- (5) The kidney was firmly fixed.
- (6) The suprarenal glands with adipose tissue which are found above the kidneys were in their normal position in the epigastric region.

These cases exemplify the two main types of dystopic kidney. The first type, to which the first four cases belong, being the single ectopic kidney with the other kidney in its normal position. The single ectopic kidneys were of the pelvic type, situated over the sacral promontory. All showed infection; one was mistaken for an appendix abscess, even though it was on the left side; another was thought to be some intestinal condition. All were associated with bladder symptoms. In none of them was there any other congenital

anomaly. Three showed large hydronephrosis which is a condition quite common to such kidneys. Another showed a tuberculous renal occlusion. The interesting anatomical and developmental fact about Case IV was the absence of perirenal fat around the kidney and its presence in the normal position, also the presence of the adrenal body in its normal place, indicating the difference of development of these different structures. I can find no satisfactory description of the development of the perirenal fat and its relation to the development of the kidney. The other cases represent the fused type of ectopic kidney. The first, Case V, being a unilateral type and Case VI the central type.

Ectopic kidney is supposed to occur once in every thousand autopsies and distributed about equally as to sex. Compared to other renal anomalies, it occurs in 16.9 per cent., according to Borland, who collected 121 cases of anomalous kidneys in 1910.

I believe that with systematic investigation with the X-ray and ureteral catheter, this condition will probably be found more frequently. The vascularization of the ectopic kidney has been the subject of considerable debate. Plummer in *Surgery, Gynecology, and Obstetrics*, in 1913, gives a complete summary of the condition and quotes various authorities. The general idea seems to be that a kidney has no permanent vascularity until it reaches its final position. If the permanent position is normal, the vessels are normal; if otherwise, the vessels arise from some nearby arterial trunk and tend to take a direct course to the kidney.

Some authors believe that the blood-vessels have an important influence in the ascent of the kidney—that the kidney is lifted to its final position, as Chute says in his recent article read before the American Association of G. U. Surgeons, in a sort of hand-over-hand manner, the upper vessels being the larger and stronger, and the lower ones becoming atrophied and letting go. Chute says it is the persistence of the vessels which should have atrophied in certain instances which brings about the kidney's inability to empty itself that results in hydronephrosis, which is so common.

Such kidneys are usually normal in size, though often they are found small. The most common resting place seems to be over the promontory of the sacrum, the impression on the kidneys of the bifurcation of the aorta is a common finding. The blood supply usually comes from the lower part of the aorta or from the internal iliac vessels or their branches. Accessory vessels are frequent. The vascular supply of Case VI is very interesting, particularly in two features, first, that the middle sacral has assumed the function of the renal artery and two, that the internal spermatic on the left went to the left suprarenal vein. Since normally the suprarenal veins empty into the renal, it may be that the renal vein is a composite of the suprarenal and renal. The ureter is shorter than normal and is very frequently extremely taut, as in my second case. It usually enters the bladder at its normal site and the kidney on its anterior surface.

The left kidney seems more prone to ectopy than the right, in contradis-

tion to the floating kidney. The ectopic kidney is occasionally found during abdominal operations. On account of its atypical position with its resulting pressure and its ureteral insertion, hydronephrosis and pyonephrosis are frequent in their occurrence. The usual lesions have been observed in such kidneys. *

Symptomatology.—There may be no symptoms whatever from such a mal-posed organ, and, as was said before, they are often accidentally found. The most common symptoms are pelvic, lower abdominal and urinary. They are frequently mistaken for tubo-ovarian diseases and occasionally intraperitoneal conditions, particularly when the kidney has become infected.

Rectal symptoms have been noted as quite ordinary in the pelvic type of kidney. It is interesting that Case VI had had during life considerable rectal trouble and had undergone a rectal operation.

Two of the cases illustrate the importance of the urinary examination. Both were thought to be abdominal conditions, but the urinalysis gave the first clue to the true nature of the lesion. The diagnosis is quite simple with the present-day methods and needs no comment, and it shows the great value of combined ureteral catheterization and radiography. It shows how easily one could be led to believe that one was dealing with an infected kidney in its normal position since the catheters usually go their full length.

One should have no trouble in differentiating such a condition from a movable kidney.

Aside from the usual findings, one point which is not usually spoken of is that the pyelogram of the pelvis of an ectopic kidney is almost invariably centrally located over the spine, whereas the pyelogram of a floating kidney is lateral.

The treatment should be expectant in the pelvic kidney which is causing little or no disturbance, except possibly a few reflected pains, particularly if the kidney shows no infection.

In young women who are liable to become pregnant, nephrectomy is indicated, it is for this reason that Chute removed the kidney in a quoted case, as it would have had an extremely deleterious effect on pregnancy and pregnancy on it, although there have been cases reported of pregnancy going to term in the presence of an ectopic kidney.

It is easy to see how serious an effect such a kidney as Case VI would have on pregnancy, the chances are that pregnancy would have to be terminated.

Streeter lays down the following rules: First, "If discovered at the beginning of pregnancy, laparotomy, dislocation or fixation should be done. Second, if discovered later, consider the advisability of the induction of premature labor. Third, do not remove a normal kidney shortly before or during labor. Fourth, if discovered after labor has begun, a pathological kidney may be punctured to allow delivery and a nephrectomy done after."

If they misbehave, and when they become badly infected, nephrectomy is the only operation, provided the condition be unilateral.

Some authors have advised dislocation and reimplantation to relieve the mechanical results, but it is personally felt that this operation is hazardous. In the large unilateral fused kidneys, such as in the fifth case, there is nothing to do but elevation and fixation. In this instance it worked very satisfactorily.

The usual operation has been done by means of ventral laparotomy. Sacral operations have been done, but are difficult and unsatisfactory.

Vaginal nephrectomy has been reported by Cragin. I feel that there is no question from personal experience that the extraperitoneal operation with proper abdominal incision is the method of choice. One needs free exposure because the kidney is so firmly fixed and adherent to very important structures.

For this reason, the crucial incision which was made in one case, simplified the whole procedure and made a difficult operation a very simple one. I would suggest its more frequent employment.

ADVANTAGES AND DISADVANTAGES OF METAL PLATES IN THE TREATMENT OF FRACTURES OF THE LONG BONES*

BY ALFRED STILLMAN, M.D.

OF NEW YORK, N. Y.

MR. LANE, in 1909, said that for sixteen years he had made it a habit to operate on all cases of simple fracture of the long bones, in which he was unable to restore the fragments to their normal relationship and in which it was important to the individual that his mechanics should not be impaired. He advocated the use of plates and screws as the means of maintaining reduction and described a careful technic in operating. Through him surgery of fractures received a tremendous impetus.

His method seemed to overcome so well many of the difficulties in the treatment of fractures it was tried out with considerable enthusiasm. The literature was soon filled with articles on platings, on the kind of plates and screws to use and the instruments necessary to apply them. When reports began to accumulate it was seen that platings had some drawbacks. Operative wounds became infected, plates broke and screws loosened under strain and much of the benefit of operation was lost.

While opinion as to the worth of Lane plates was still in abeyance the war began. Fractures had to be treated literally by the thousands. They were nearly all compound, comminuted and infected. It was found that suspension and traction, particularly skeletal traction, best met the requirements. Many surgeons became familiar with the method and have found it more and more applicable at home. In fractures of the femoral shaft, where the Lane plate was expected to supersede all other methods of treatment, suspension and traction has now won out as safer and as certain of results.

Thus, owing to fear of the besetting dangers of the open operation and increasing appreciation of suspension and traction, plating is mentioned under the breath. "Whether right or wrong," Freeman says, "when an idea has once gained credence among surgeons it has a tendency to stick. This conservatism is good insofar as it prevents the easy acceptance of half baked theories, but it is unfortunate when it inhibits the introduction of new and valuable procedures as it sometimes does." Are we right or wrong in this growing suspicion of the Lane plate? Has it a proper usage? Do the dangers outweigh the advantages?

To help answer these questions I have examined the records at the Roosevelt Hospital and looked up what other statistics I could find. We have 66 platings done on 63 patients by a dozen operators. With the exception of six fractured femurs all cases were operated since 1912.

* Read before the New York Surgical Society, February 28, 1923.



FIG. 1.—Fracture of upper third of shaft of ulna and of neck of radius. X-ray taken seventeen days after accident shows result of treatment in dispensary. X-ray taken on thirtieth day after accident shows operative result. On the eightieth day plate was removed. Function at this time perfect. Union firm, slight angulation of ulna.

Infection.—Babler of St. Louis in 1912 reported 66 platings with 19 infections, or 28 per cent. Wight of Brooklyn, in 1920, reported in 263 open reductions 69 infections, or 26 per cent. These reports make infection appear formidable. Sherman of Pittsburgh, in 1912, however, reported 55 platings with 2 infections, or less than 4 per cent. In our cases there were 7 infections, or 10.6 per cent. Three infections occurred in fractured femurs, 2 in tibias, 1 each in a radius and a clavicle. The infection was noted in 2 femurs only at removal of the plate. All infections healed promptly. Both tibial infections were in compound fractures.

Infection sometimes occurs at the site of a fracture not operated, and it cannot always be avoided in compound cases operated upon but usually it is due to faulty technic. If Lane's dictum, to touch no sponge, suture material or part of an instrument that goes into the wound, is carefully carried out, infection should be kept down to 5 per cent., and when it does occur should be mild.

Delayed Union.—Opinion is nearly unanimous that plating delays union. Statistics to prove it, however, are meagre if not lacking. Estes of Bethlehem has determined the percentage of delay after the closed method of treating fractures. He tabulated the time of union in uncomplicated cases for each location and found the majority united within certain limits. All fractures requiring eight days more than the upper limit were regarded as showing delayed union, and union was considered to have occurred when there was no vestige of abnormal mobility at the site of fracture. Counting non-union with delayed union he found in 240 fractures of the shafts of long bones union delayed in 11 per cent. of fractures of the humerus; in 25 per cent. of the femur; in 26 per cent. of the radius and ulna; and in 32 per cent. of the tibia. In comparing his plated cases there were six delayed unions out of 24, or 25 per cent. There were no delays in the upper extremity but in the lower the percentage was higher than in the closed method—33 per cent. for femurs and 57 per cent. for tibias.

I am chagrined to find so little information in our histories of fractures as to time of union and as to functional results. There is some excuse for this, of course, owing to the fact that many fractures, other than those of the femur, leave the hospital when we are assured that their wounds are clean and supporting apparatus efficient. They return to have splints or casts removed when union is noted, but the fact and date of occurrence, unfortunately, do not get put upon their records which are no longer at their sides.

The only group in which there is sufficient evidence as to the progress of union is the tibial. Three showed union within normal limits, eleven were delayed and one lacked data. These figures give 70 per cent. of delay after plating. But seven of these fractures were compound, and compound fractures themselves require a longer period for union than the uncomplicated. These groups are too small in numbers to settle the question of delayed union after plating, but are on the side of the very generally expressed opinion in the affirmative.



FIG. 2.—Fracture of shaft of ulna compound comminuted, and fracture of radius after attempt at reduction. Shows result of operation on ulna done five days after injury and on radius nine days later.

Theoretically, delay should be less frequent after plating for the three principal causes of delay—separation of fragments, interposition of soft parts between fragments, and faulty immobilization—should all be eliminated with a properly applied plate. It may be that the operation is done late. Delay from this cause seems subject to a fairly satisfactory explanation. The original fracturing injury is the greatest stimulus to repair. Operating after repair has begun disturbs or destroys that repair which must start fresh with its stimulus somewhat spent.

Wight, in his statistics of operations on 263 fractures of long bones, gives eight weeks as the average time of union in recent cases as compared to eighteen weeks in old cases. But what is "recent" and what is "old" in time? One infers that "old" means three weeks, a month or more. It is seldom specified. But it should mean much less than that if it is to be considered in terms of delayed union. We know that the first few days after fracture are spent in absorbing blood clot, debris, etc., and the next few days in forming connective tissue which is acted upon by the osteoblasts to form provisional callus, and this may be nearly complete at the end of a week. The callus hardens when lime salts are deposited in it. The whole process can be very short. Therefore, I think, "old" should mean after the first week and the preferable time to operate about the third day.

Another point about union, it is difficult to decide if it has taken place after plating, for the plate, unless the screws have loosened, gives firmness at the fracture. One has to estimate union by the amount of callus as shown by X-ray. It is notable that fractures, the ends of which are in perfect apposition, show less callus than those the ends of which are somewhat separated. One may decide, therefore, that union has not yet taken place after plating because the amount of callus is small.

Finally, *union after plating*, providing it occurs, is of secondary importance. What one expects or hopes for is an anatomically and functionally correct limb, and this can be shown to be more frequent after platings than after the closed method.

Sir Robert Jones, reporting the findings of a Special Committee of Inquiry of the British Medical Association, gave 70.5 per cent. good results in primary operations on 147 fractures as compared to 53.3 per cent. good anatomical results plus 16.1 per cent. good functional result, despite a poor anatomical one in 2596 non-operated cases, or 69.4 per cent. as compared to 70.5 per cent.

In our series, the femoral group only provide sufficient information as to results. Of 32 cases, 3 died and 3 lack data. Eighteen of the remaining 26 had no shortening or deformity; 2 had one-quarter inch shortening, one with no deformity, the other with slight bowing; 3 had one-half inch shortening, 2 with no deformity and the third with slight bowing; 2 had one inch shortening with angulation, and 1 is marked "considerable angulation." As one-half inch of shortening is easily compensated without lameness this amount is taken as a satisfactory result. There are, then, 23, or 88 per cent., within this class.



FIG. 3.—Antero-posterior view of a case plated thirteen years ago with an aluminium plate.

However, three of these had limitation of flexion, two to 45 degrees and the third to 5 degrees, which reduces to 76 per cent. the excellent results. Two of these latter three had extenuating circumstances connected with the limitation of flexion; one a boy of 18 had a fracture of the condyle leading into the joint, the other a woman of 43 had a compound fracture with badly injured extensor muscles. These figures fall slightly below those of the British Committee, but the reason may be that they were those of the most difficult group in which to get results.

The three deaths referred to occurred, one from shock, one from lung abscess on the 28th day post-operative, and one from bed-sore sepsis on the 38th day post-operative. The latter was a man of 60 years, treated first by caliper traction but whose skin would not stand the pressure caused by a confined position. He was operated in the hope that in a cast he could be turned often enough to relieve the sore points.

A mortality rate of 3.3 per cent. (I do not count the bed sore sepsis death, as it was in no way connected with the operation) is a serious drawback to open reduction. As the deaths occur mostly in operations upon fractures of the femur, as these cases are now probably better treated by caliper traction and as few femurs henceforth will therefore be plated, the mortality rate should be brought to less than 1 per cent.

Breaking of plates occurred more frequently formerly than now. They are better made and can stand all the strain required. They should be tested with heavy forceps, however, before being used. This was not done in one of our cases and eight days post-operative, while adjusting the leg at an inspection of the wound, the plate was heard to snap. In one other case, a refracture of the femur occurred through the callus, at which time the plate was broken.

I have records of removal of 26 plates, 14 of the 15 in the tibial group, 10 of the 32 in the femoral group, 1 from the radius and 1 from the ulna. Mr. Lane does not think they need to be removed, but I feel it wiser to do so in most cases as soon as they have accomplished the desired result.

Loosening of the screws is one of the trying after events of platings. This more often happens in an old fracture with considerable displacement where the muscles have had time to set in contraction. The reduction which the screws must maintain will then be against strong resistance. Unless the external fixation assumes most of this strain the screws will loosen. The bone of a young growing individual is poor holding ground for screws. When platings are done within the first few days after fracture the screws will hold for the muscles are then in balance and produce no strain.

Unfortunately, most of the operations are done late. Of 57 cases with information as to time, after accident, of the operation 16 were operated in the first week, 13 in the second, 9 in the next two weeks and 19 in the second to the sixth month.

The indications for the use of Lane plates are three: (1) When proper reduction cannot be maintained without direct fixation of the fragments.



FIG. 4.—Lateral view of a case plated thirteen years ago with an aluminium plate.

- (2) When non-union is the result of too great separation of fragments.
- (3) When faulty union has taken place.

Under the first indication a qualification, by Ashhurst and John of "proper reduction," is so pertinent it is worth repeating: Impossibility is a relative term since what is impossible for one surgeon may not be for another; and the word "proper" reduction is employed not to imply that operation is indicated whenever accurate, exact perfect anatomical replacement is impossible but only when such degree of reduction as is requisite for proper function cannot be secured without operation. Also they consider "cannot be maintained" a relative condition depending upon the skill of the surgeon in devising and applying efficient retentive apparatus and upon the extent to which displacement occurs.

With regard to the second indication it may be questionable whether bone grafting is not a better procedure. To most of us the plating will appeal as easier and not necessitating an injury to another bone. Probably plating will be tried first in the majority of cases.

With faulty union other methods no doubt will be tried, but plating seems as good as any.

In our series plating was performed once on a clavicle, 4 times on the humerus, 5 times on the ulna, 9 times on the radius, 15 times on the tibia and 32 times on the femur.

To sum up.—Plating is a justifiable procedure in a properly equipped institution and in the hands of a careful surgeon.

What statistics there are, tend to confirm the nearly unanimous opinion that plating delays union.

However, the time elapsed after fracture before operation may be as important a factor in the cause of delay as the plate itself.

Delay of union provided union takes place is of little consequence, compared to the better results to be obtained by plating.

Now that fractured femurs are treated almost entirely by suspension and traction, plating will not be done as often as formerly, but when limited to the lesser bones should give even more satisfaction.

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WOUND OF FEMORAL ARTERY AND VEIN

BY COURTNEY P. GROVER, M.D.

AND

DAVID FISHER, M.D.

OF DAYTON, OHIO.

FROM THE SURGICAL SERVICE OF THE NATIONAL MILITARY HOSPITAL

BULLET wounds of large blood-vessels are comparatively rare occurrences in civil life, and are apt to be seen only in the large general hospitals. This is particularly true of that class of cases which comes under the observation of the surgeon at a late date subsequent to the injury, for relief, not for the original wound, but for some complication thereof, which impedes his daily routine. The old idea that perforation of a large blood-vessel meant sudden death unless immediately checked has long been dispelled by a formidable array of case reports in the literature showing recovery to be the general rule, even in very long-standing injuries. Immediate fistulous communication and clot formation covering it have been life preservers, and one is almost inclined to the belief of the purposefulness of all the acts of nature when such a case comes under his observation.

The following case we consider unusual, not only because of the length of time elapsing between the date of injury and operation, but principally because of the destructiveness of the lesion, the bold method of treatment, and the results obtained. The management of this lesion herein to be described refuted many of our categorical ideas, but at the same time drove home with vigorous emphasis much which has already been laid down as clinical fact by that great path finder, Halsted.

Case Report.—J. E., Jr., single, age twenty-nine, entered the National Military Hospital, Dayton, Ohio, June 27, 1922, for relief of pain and swelling of the left thigh. The family and past history were essentially negative except for an old fracture of the left ulna which united in excellent alignment.

Ten weeks before admission while holding an automatic in his hand it exploded, the bullet entering the left thigh at the inner side midway between the head of the femur and the knee-joint. He says that the blood "came out in gushes," he walked to the nearest physician, who tried to remove the bullet and stop the bleeding. The doctor probed the wound, treated it with phenol, and bandaged it, which measure stopped the blood flow. Patient returned home feeling fairly comfortable.

One week later he felt a dull continuous pain at the site of injury and noticed a slight swelling of the affected thigh. The pain and swelling gradually increased, the pain becoming so intense one week ago as to render locomotion impossible.

Physical examination showed a well developed male weighing 160 pounds. The left thigh was greater in circumference by 6 cm. than the right; marked varicosities were plainly discernible even at a distance. At the apex of Scarpa's triangle was the irregular scar of the wound of entrance. The wound of exit

was 9 cm. down, inward and slightly posterior. On palpation, the skin of the thigh was hot and under marked tension, very similar to brawny cedema. Deeper palpation met with marked resistance and elicited severe pain.

The knee-joint could not be moved without acute suffering. The popliteal and dorsalis pedis arteries were not palpable. T. 99.8, P. 84, R. 22. Blood: Hg. 85, W. B. C. 6800, Coag. time 5 minutes. Urine: Dark, cloudy, acid, sp. gr. 1030, slightest possible trace of albumen, no sugar or casts.

The patient was operated upon by Doctor Grover with Doctor Fisher assisting. Upon entering the affected area, a large irregular reddish-black mass presented, resembling an old blood clot. This was carefully removed, and in so doing, we were amazed at its tremendous size. As soon as the thrombus was out of place, for such it was, a large stream of blood gushed forth. The large cavity of the wound was immediately packed with gauze and by tightening down on a tourniquet, the blood was checked and seen to have come from the femoral artery. The femoral artery showed a longitudinal jagged rent 3 cm. in length, and laid open across its entire diameter; the accompanying vein was likewise torn open, but at a slightly lower level. The artery and vein were both ligated doubly, with No. 3 chromic catgut proximally and distally, and the injured portions removed. A gutta serena drain was placed in the large cavity left by removal of the thrombus, which weighed four and one-quarter pounds. No normal muscle tissue was seen in the wound and all detritus was carefully removed. The patient returned to the ward in moderate shock. The next day the temperature rose to 101.6 and the wound was draining freely. For the next four days the temperature ranged from 99.4 to 100.6, the wound draining pus the last two days. On the fifth day the temperature fell to normal and drainage ceased on the ninth day. From then on the convalescence was uneventful.

Three weeks following operation, the left thigh was no larger than the right, the patient walked freely, easily, without pain or limp; the popliteal and dorsalis pedis arteries were not palpable; the left leg felt warm, easily bled upon pin prick and in every way seemed as normal as the right side. Four weeks after operation the patient was discharged. He was last heard from five months after operation, carries on his daily routine and has forgotten all about his wounded leg. No untoward effects were at any time noticed.

As this case shows, the method of treatment obtaining best results is ligation of artery and vein. To do less is to secure less. Others may maintain that end-to-end anastomosis or vein graft to repair arterial defect have advantages over ligation, but one can reasonably doubt this, since end-to-end anastomosis implies freeing the artery from its resting place for a considerable distance, and tension in bringing the ends together. Such a procedure may be preferable in dealing with the popliteal artery, but in the case of the femoral, the literature is too replete with recoveries following ligation to admit of the other method. LaRoque has discussed this question admirably, and is definite in his preference for ligation. Even in cases in which infection has taken place, gangrene is so rare following ligation of the femoral, that one can hardly bring himself to believe that end-to-end anastomosis is preferable. Halsted has definitely shown that aseptic ligation is not followed by thrombus formation.

The question often arises should the vein also be ligated whether it be injured or not. Halsted, Neuhoff, St. John, and many French and English

surgeons, as a result of their war experience conclude that there is less danger of gangrene when this is done.

There is no particular necessity for performing the operation immediately. The patient either bleeds to death at once or survives. The immediate danger is acute dilatation of the heart due to the fact that the blood is unable to get by the large thrombus, or if an arteriovenous fistula has formed it is returned immediately to the heart, throwing too great a burden and too sudden a one upon this vital organ, causing acute dilatation. Halsted has clearly shown this. If the proximal end of the artery dilates extensively, it carries with it all the dangers of an arterial aneurism, including the development of gangrene. If the wound is not operated within the first 36 to 48 hours and no inflammation is present, the operation can be performed at the leisure of the surgeon. Our case waited ten weeks, and probably would have waited longer had not inflammation arisen which caused acute pain. A large percentage of all wounds of large blood-vessels in civil life are due to bullet and stab wounds. Other reported causes, however, are fracture at hip or shoulder, accidental wounds in operations upon hernia, carcinoma, inguinal glands and abscess, and one case of rupture of iliac, due to removal of a drainage tube following removal of ureteral stone low down.

We wish to express our thanks to Col. James A. Mattison, M.D., for his helpful suggestions, and for his permission to publish this case.

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TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held January 8, 1923

The President, DR. JOHN H. JORSON, in the Chair

RUPTURE OF TENDON OF EXTENSOR LONGUS POLLICIS

DR. ASTLEY P. C. ASHHURST read a paper with the above title.

PLASTIC REPAIR OF CHEEK

DR. GEORGE M. DORRANCE presented a case to illustrate the pedicle method of closing the defect. The patient had had a carcinoma of the mucous membrane of the left cheek and left half of the inferior maxilla with swelling in the submaxillary region. Dr. Wm. L. Clarke had treated the malignancy with radium and X-ray, and requested him to remove the left half of the inferior maxilla. This was followed by fulguration of the entire malignant area, and more X-ray and radium. When next seen the wound was entirely healed and he had a defect of the left cheek measuring $1\frac{3}{4}$ by 2 inches. As all the cheek still showed the effect of the X-ray, it was impossible to use the surrounding tissue. A pedicle-tubed flap from the neck and chest was employed. The pedicle was raised and tubed. Ten days later a flap was outlined and the end of the flap was turned in to form the inner lining. Seven days later when the two surfaces of the flap had united, the turned-in end of the flap was divided where it turned over; the flap with the pedicle was raised. This flap had an inner lining that could be sutured to the mucous membrane on all sides and an outer lining that could be united on three sides to the skin edges. The edges of the defect in the cheek were freshened and the mucous membrane with a small amount of underlying tissue turned in. The skin edge was raised and turned outward. The flap was united both on the mucous membrane and skin edges. The pedicle was divided on the tenth day and returned to its former bed. The free skin edge of the flap was sutured to the surrounding skin. The main point in this operation was the formation of the inner lining that allowed it to be sutured to the surrounding mucous membrane in all parts.

DR. A. P. C. ASHHURST had had two fatalities from secondary hemorrhage in operations of this nature. Both patients had carcinoma of the mucous surface of the cheek and he thought death occurred because he tried to do the whole operation in one sitting. Hotchkiss had devised an operation restoring the cheek by turning up a flap from the neck, which had proved satisfactory. Von Eiselsberg splits the tongue horizontally and turns it up to the upper alveolus, to form the inner wall of the cheek. Both of his fatal cases did well for a time; after ten days or so they had secondary

hemorrhage from the carotids. Doctor Dorrance stated that in his cases one year elapsed between the beginning of treatment and the final closure of the wound of the second operations. If his patients had not died their wounds would have been closed in a few weeks.

ANAPHYLAXIS FOLLOWING BLOOD TRANSFUSION

DR. GEORGE L. CARRINGTON read a paper with the above title, for which see page 1.

DOCTOR PFEIFFER had also had a disconcerting experience with transfusion several months ago which he had been unable to explain. The patient, a Jewish woman, aged thirty-eight, was admitted to the Abington Memorial Hospital, May 29, 1922, suffering from bichlorid poisoning with the usual accompanying nephritis and enteritis. The day after admission, both kidneys were decapsulated by Doctor Outerbridge on account of the scantiness of urine, almost amounting to suppression. She became progressively more anæmic and on the third of August, 1922, her blood count was 27 per cent. hæmoglobin; 2,050,000 red blood cells; 7600 white blood cells. Transfusion was done on the following day. The donor was her husband, a healthy, full-blooded man, who showed no abnormalities of any kind. Examination showed that both the donor and recipient belonged to group No. 4. Both agglutination and hemolysis tests were negative. Accordingly, he proceeded to make the transfusion by the usual citrate method. There was no technical difficulty or delay or departure in any respect from the usual technic and procedure. The tube and supplies had been used a number of times before for the same purpose and the citrate solution was fresh and sterile.

After about 25 c.c. of blood had been transfused into the patient's vein, she complained of oppression. Transfusion was stopped at once, and she immediately developed what seemed to be a typical anaphylactic shock. The pulse became very small, rapid and weak; the breathing was labored; the face became a livid red. She complained of intense pain throughout her body, especially in the back. She retched but was unable to vomit because the stomach was empty. She was given atropin, 1/100 gr.; 20 m. of adrenalin chlorid, 1-1000. Her feet were elevated and hot water bags placed around her. The temperature rose to 103.4, the pulse to 150. She gradually improved, and except for extreme weakness, was none the worse on the following day.

Whether or not this reaction was in any way beneficial, may not be known, but her blood picture began to improve gradually. Four months later the hæmoglobin was 70 per cent.; red blood cells 3,730,000. She felt perfectly well. The urine, quantitatively and qualitatively, was practically normal. In the attempt to explain this reaction, her husband's blood and her own were again compared with the same result as before. This case therefore showed a typical anaphylactic shock, the possibility of which could not be determined by the usual examinations upon which we rely to determine compatibility.

NEURITIS AND PERINEURITIS OF ARM

DR. J. STEWART RODMAN presented a patient, male, thirty-seven years of age. Admitted to Dr. J. H. Jopson's Service, Medico-chirurgical Hospital, April 25, 1922, complaining of pain in right arm. Previous medical history.—Appendectomy twelve years ago. Twenty-four years ago left leg severely crushed in railroad accident requiring amputation at middle third. Denies venereal infection. Present Illness.—On November 1, 1920, patient's right hand just above the thumb was burned with hot lead and zinc chloride. This burn was treated for the next eight days by usual applications. On the eighth day, tincture of iodine was used and a bandage applied. That night hand became markedly swollen, after which he applied hot magnesium sulphate. It was again treated locally for two weeks, at the end of which time an incision was made over the dorsum of the hand and pus was evacuated. Three weeks later, two incisions were made in the forearm near the elbow, pus being evacuated. One month later, an incision was made in the arm above the biceps and also over the shoulder-blade on the right side. From the start, pain in the right arm has been continuous. He has full motion but pain is severe.

Physical examination shows that left leg has been amputated, middle third; no scars other than operative ones on right arm and over right scapula. Teeth in poor condition, many missing, those present decayed, marked pyorrhea. General examination otherwise negative. Examination of right arm shows marked inability to use arm or hand which, however, seems to be due to pain, which is greatly intensified on efforts at passive motion. There is tenderness in the arm and hand, but is not greater over the nerve trunks than elsewhere. No muscular atrophy, biceps jerk present. Tactile sense good. Pain sense is great in most places but in some smaller areas does not apparently feel prick of a pin, but these spots have no relation to the nerve supply. In the upper arm urticarial wheals appeared where stuck with pin, also hyperemia about these areas. Skin is not smoothed out or shiny as one would expect from a neuritis.

Operation May 10, 1922, Dr. J. H. Jopson. Sympathectomy on right brachial artery. As no improvement followed this procedure, I was asked to see the case three weeks later. Suggested that a posterior rhizotomy might be considered. At the suggestion of Doctor Jopson, Doctor Spiller was also asked to see the patient, and he suggested that, instead of performing a rhizotomy, alcohol should be injected directly into the nerves responsible for the pain from which he suffered. In order to relieve his pain, it was necessary that the median, musculospiral, ulnar, and musculocutaneous nerves be injected. This matter was fully discussed with the patient, it being explained to him that a paralysis would result which would probably be temporary but might be permanent. The patient, however, was suffering from such extreme pain and had been for so long, that he eagerly welcomed anything that offered him relief. Accordingly on June 7, 1922, the median, musculospiral, ulnar and cutaneous nerves were exposed and 80 per cent. alcohol injected. This caused an immediate relief of pain and, of course,

complete paralysis of the forearm, wrist and hand. This relief of pain lasted for six weeks and returned with a return of function at that time. He was then admitted to the Presbyterian Hospital and on July 17, 1922, the median, ulnar, and musculospiral nerves were again injected with 80 per cent. alcohol after direct exposure. This time there was also an immediate relief of pain with paralysis of the forearm and wrist which has lasted to the present time.

DR. WM. J. TAYLOR remarked that in England in June of 1918, he had seen a good deal of this work which had been done at the nerve hospitals by Colonel Sanford and Colonel Buzzard. They used the method particularly in the treatment of causalgia; they cut down on the nerve to expose it and injected into the normal nerve above the wound whenever injury had been done to the nerve. They injected first 80 per cent.; other cases 70 per cent., and finally 60 per cent. alcohol, producing temporary paralysis almost without exception and some little disability. He had only had experience with two cases himself. One was a man in France who was shot by a rifle in the posterior tibia. The wound healed up and the man was apparently well, but suffered great pain. He had heard of the work of Buzzard, so he cut down on the nerve, and on exposing it found that the bullet had taken a piece out of the side of the nerve and a neuroma had grown over it. Being with the British, he would not have the right to do any nerve resection, so he injected him with 60 per cent. alcohol in the normal nerve about one inch above the neuroma. He had instant relief of his pain and discomfort, and went back to England, so he lost sight of him.

The second case was that of a young woman here in Philadelphia who got her wrist caught in a broken windshield, and was treated by a doctor who ligated the radial artery. Some time later she had a secondary hemorrhage which was stopped with pressure. She came to Dr. Francis Sinkler complaining of pain which finally extended up the arm, involving the posterior nerve roots. Doctor Taylor was extremely anxious about this patient, and on cutting down found the ulnar nerve and stump of the artery bound down in adhesions. The nerve was swollen and painful. The adhesions were loosened and 60 per cent. alcohol injected into the nerve itself. Paralysis of the ulnar nerve resulted with complete relief of all pain in the arm. She made a good recovery with complete return of all movement. It is nearly three years now and she is still well.

There are certain points in the question of technic. The nerve should be exposed absolutely. One should use the finest kind of a needle, and you must inject directly into the nerve itself, being careful in moving the needle about that it is fixed in the nerve and not between the nerve fibres. Inject slowly until you have distention. The nerve will look almost as if it were preserved in alcohol. The treatment has a limited application; you may have permanent paralysis; but where pain has been present for a year or two, and the pain and suffering is something indescribable, it seems to be worthy of application.

PERFORATION IN UTERO OF A GASTRIC ULCER

DOCTOR RODMAN stated, in closing, that it would have been much easier to have exposed the brachial plexus in the axilla and to inject that, but this was not done because a paralysis as high as that level was not desired. The pain was greatest in the forearm and in the wrist joint. This method was suggested by Doctor Spiller and while thought a drastic procedure, it seemed entirely justifiable in this case. The arm was held rigidly in a semiflexed position and the patient could not use it at all because of the extreme pain caused by motion. He did not want to give the impression that he believed this to be the first case in which alcohol injection had been done to relieve the pain of a neuritis, but rather that so far as he knew it is the first. The case is interesting because an entire group of nerves responsible for motion of a part of a limb have been deliberately injected with alcohol (80 per cent.) in order to relieve the pain of an ascending neuritis involving these nerves. A posterior rhizotomy was considered because it was thought by cutting the posterior roots of the cervicals, the 4th, 5th, 6th and 7th and the first dorsal, pain would be relieved but motion preserved. This was discarded because Doctor Spiller thought the fact that after such a rhizotomy the patient would lose all muscle sense and that this would make his arm useless and, of course, this would be permanent, whereas the effect of alcohol injection, although causing a complete paralysis for the time being, should be temporary. Posterior rhizotomy for various causes has been performed before in the cervical region by Abbey, C. H. Mayo and others so that there was ample precedent for considering this procedure. This patient can flex the elbow on the injected side and, of course, move the arm on the shoulder. He, however, has complete loss of sensation below the elbow joint and a wrist drop. On neurological examination made to-day, it was found that stimulation of the musculospiral, median and ulnar nerves, at and above the points of injection, does not result in any motor response with either current. There is the same result of stimulation of the nerves below the lesion. A stimulation of the motor points of the muscles of the respective nerves injected with the faradic current results in no response; with the galvanic current there is a sluggish hypo-excitable response with negative closing of conduction almost equal to positive closing.

This patient still shows, therefore, complete paralysis below the level of injection of the nerves in question, that he has had a complete surcease from the intolerable pain and is well satisfied with the result. Neurological opinion is that while six months approximately have elapsed since these nerves were injected, he is still well within the average time for reestablishment of sensation and, therefore, has a reasonable prospect of regaining the use of the forearm and hand.

PERFORATION IN UTERO OF A GASTRIC ULCER

DR. WALTER ESTELL LEE and DR. J. RALSTON WELLS read a paper with the above title, for which see page 36.

ACUTE INTESTINAL OBSTRUCTION CAUSED BY
MECKEL'S DIVERTICULUM

DR. J. STEWART RODMAN related the case of E. T., male, twenty-six, chauffeur, admitted to Dr. F. O. Allen's service at the Presbyterian Hospital, June 10, 1922, complaining of obstipation and pain in the abdomen. Present illness began with sudden severe pain in epigastrium about thirty hours prior to admission, having been perfectly well prior to this time. This pain has been constant and exaggerated periodically. At the time of admission it radiated from umbilicus to pubis and thence outward to each flank. Has vomited frequently since the onset of the pain. Seidlitz powder and magnesium citrate ineffectual as well as enemas for two and one-half days. Bowels usually regular. Examination negative, except for abdomen, which was tympanitic in upper portion. Dull below.

Peristalsis active throughout. Tenderness in hypogastrium and lower umbilical area. Pressure in iliac fossæ causes pain in hypogastrium. No masses. Rectal examination negative. Diagnosis: Acute intestinal obstruction.

Operation.—Ether anæsthesia. An incision was made in the median line between umbilicus and symphysis. On opening the peritoneal cavity a small amount of clear straw-colored fluid escaped. The small intestines were dark in color and distended proximal to a point in the right side of the abdomen where a large mass adherent to the posterior parietal peritoneum was felt. The bowel below this point was collapsed. On separating adhesions binding the mass to the posterior parietal peritoneum it was seen that a loop of small bowel had wrapped itself around and become firmly adherent to what proved to be a large Meckel's diverticulum. After freeing the bowel this diverticulum was found to be about $4\frac{1}{2}$ cm. in length and about 2 cm. in width with two small diverticula at the distal end. The fluid contents were milked out of the lumen of the diverticulum into the bowel. It was then clamped across its base and removed with the cautery. The stump was closed with a through-and-through suture of No. 1 chromic catgut and covered over with a continuous Lembert stitch of linen. The abdomen was closed in layers without drainage. Recovery was uneventful.

Meckel's diverticulum while not a common operative finding is still not sufficiently uncommon to be considered any longer a surgical curiosity. Realizing that this condition was not so rare therefore as to warrant an exhaustive search through the literature, it was thought that it might be of interest to go over the Transactions of the Academy in order to find out how frequently Meckel's diverticulum has been reported as an operative finding before this body. This was done with the following result: In 1903, Dr. W. J. Taylor reported the first instance of this condition which appears in the transactions. His patient, a young woman of twenty, gave symptoms of acute intestinal obstruction and at operation a band was found constricting the small intestine about thirty-two inches from the cæcum. This band proved to be a remnant of Meckel's diverticulum. In 1907, Dr. J. B. Roberts reported three cases, one upon which he had operated, finding a Meckel's diverticulum causing

BULLET WOUND OF PREGNANT UTERUS

constriction of the small bowel and thus intestinal obstruction in a boy four and one-half years old. This case recovered. Of the two other cases a Meckel's diverticulum was seen during the course of an operation for another condition and one was found at autopsy. In discussing this paper, Doctor Gibbon cited three cases, one of which was causing intestinal obstruction, and Dr. W. J. Taylor referred to the case already cited, and mentioned one other upon which he had operated. No other instance occurs until 1914, when A. B. Gill reported a case of perforated Meckel's diverticulum with recovery. Seven years elapse until the next instance is recorded in January, 1921, by E. J. Klopp, his case being one of acute inflammation of Meckel's diverticulum. At the next meeting, February, 1921, E. T. Crossan and Don Lew, the latter by invitation, reported a case of acute intestinal obstruction from Meckel's diverticulum complicating acute appendicitis. At the last meeting, December, 1922, Dr. Damon Pfeiffer reported a case of perforated Meckel's diverticulum requiring resection of the intestine. In all, therefore, including my own case, there have been thirteen instances of Meckel's diverticulum reported to the Academy of which five caused acute intestinal obstruction.

DR. WM. J. TAYLOR stated that he had had one case of obstruction in relation to Meckel's diverticulum, which he reported at Johns Hopkins Medical Society meeting. He operated on a child four years of age for what he thought was acute appendicitis. On opening the abdomen a large mass was found, which he opened up, and found to be a Meckel's diverticulum twisted on itself three times, and strangulated. It was black and gangrenous and contained a number of grains of corn. It was cut off and the child made a good recovery.

PLEURAL EPILEPSY

DR. HUBLEY R. OWEN and DR. A. GONZALEZ (by invitation) read a paper with the above title, for which see page 6.

Stated Meeting Held February 5, 1923

The President, DR. JOHN H. JOHNSON, in the Chair

BULLET WOUND OF PREGNANT UTERUS

DR. J. W. BRANSFIELD reported the case of Mrs. L. T., age eighteen years, who twenty minutes before admission to St. Agnes' Hospital, April 28, 1922, accidentally discharged a revolver, the bullet striking her in the abdomen. She complained of a burning sensation with occasional cramp-like pains in her abdomen; no other discomfort. She stated she was about eight and a half months pregnant.

Examination showed bullet wound of entrance in abdomen 2 cm. below the umbilicus in midline. Uterus could be palpated and the fundus extended about 1 cm. above the umbilicus. The size of the uterus led me to believe that the patient was about at term and further questioning brought forth the information that she had been suffering from severe

pains of cramp-like character for the past twelve hours. He suspected she was in labor when injured. The point of exit of the bullet could not be found. Heart and lungs were negative. The patient was sent directly from the receiving ward to the operating room, and under ether anesthesia, the abdomen was opened by a midline incision. The bullet tract through the abdominal wall was excised. The uterus was delivered into the wound. The intestines had escaped injury, being pushed upward by the pregnant uterus. The bullet wound in the uterus was found about 3 cm. from the crest. No wound of exit was seen. A Cæsarean section was performed and a living female child delivered. The placenta was practically detached from the uterus. The membranes had been ruptured.

The child was uninjured and normal in every respect. The bullet could not be found either in the placenta or in the uterus. The uterus was closed in the usual manner and the abdomen closed without drainage. Vaginal examination made with a view of dilating the cervix for drainage revealed the cervix to be practically obliterated. The bullet was lying free in the vagina. No injury occurred either to the cervix or vaginal wall. Both patients did well following the operation and were discharged from the hospital, May 23, 1922.

TRAUMATIC LESIONS OF THE HEAD

DR. THOMAS A. SHALLOW read a paper with the above title, for which see page 26.

DR. CHARLES F. NASSAU in the discussion of it mentioned that in the Mutter Lecture a number of years ago, he had compared the results of fractures of the skull treated by operative and non-operative methods, and had looked up twenty-four cases of fractures of the skull that were not operated upon, to compare with the histories of twenty-four operated cases. At that time, following the advice of Cushing, some surgeons were doing subtemporal decompressions in cases of subdural hemorrhage. He modified this by turning down a flap over the temporal region and, if necessary, creating a large skull defect, which gave free access to all bleeding. This was closed secondarily in from three to five days. He used a large Turks' head dressing, which was not disturbed until the secondary closure. Comparison of the immediate results was startling. In the twenty-four cases treated conservatively, the mortality was 79 per cent.; the cases which had been operated upon carried a mortality of 38 per cent. In other words, the mortality was cut in half.

He did not take the standpoint that all fractures of the skull should be operated upon, and questioned very much whether any surgeon is able to save many patients with bad fractures of the posterior fossa. However, in compound fractures of the base in the middle or anterior fossa, he was of the opinion that we would obtain very much better results if more of them were operated upon. It is the one way in which all compression may be relieved, and with proper post-operative conditions chances of infection are slight, even when closure is delayed. This procedure entails no great risk, and if there is a subdural clot, it should be evacuated. This method of treating subdural hemorrhage has been practiced for many years, and he believed

that too large a percentage of cases not so treated become epileptic or have some grave changes in mentality. These cases all bleed copiously, especially when any of the large sinuses are ruptured, but he had seen only one or two complete decompressions with fatal hemorrhage. With pressure relieved, the hemorrhage is almost sure to stop.

Within the past few months he had seen a child with Doctor Jopson, and they considered very carefully whether they should operate that night. The child was not operated upon, and he now has a partial paralysis of the fourth nerve. He did not believe that the non-operative treatment was responsible for his present condition. The patient had probably a slight hemorrhage into the nerve unrelievable by surgery.

DR. J. S. RODMAN thought that one of the primary difficulties standing in the way of a clear conception of the indications for treatment, conservative or operative, was the various ideas of the underlying pathology and symptoms of these various traumatic brain lesions which differ so widely. What is concussion to one is not so to another, and there seems to be no uniformity of opinion in this regard. He had come to look upon simple, uncomplicated concussion as a relatively slight injury which will invariably clear up on the conservative plan of management. In fact, he believed there should be no particular difficulty in separating concussion, contusion and acute compression. In this differentiation an estimation of the pulse pressure is exceedingly important and he believed it a good working rule to consider an equality between the pulse-rate and pulse-pressure as an indication for operative relief of tension. In so far as eye symptoms are concerned, of much greater importance to him than inequalities of the pupil are the fundus findings, especially on the side of injury, of paling of the optic disk and congestion of the retinal veins. There can be no question, he thought, that intracranial tension can better be relieved by a large bilateral opening of the skull than by the smaller opening of a subtemporal decompression. But he had come to feel that many of these cases are going to get well without any operative procedure and that some are sure to die in spite of any operative procedure. In those suitable for operation, he preferred a subtemporal decompression, bilateral if need be, inasmuch as the defects thus caused are amply protected by the temporal muscle. He believed it is a serious matter to create cranial defects in the parietal regions, since most of them must be closed later because of the disabling symptoms they cause.

DR. BERNARD B. NEUBAUER stated that in diagnosing acute head injuries we consider the determination of intracranial pressure a very important factor. We base our treatment a great deal on what the intracranial pressure reads when taken with the spinal mercurial manometer. If the reading shows a pressure of 10 to 12 mm. or below we treat palliatively. If below 16 to 18 mm. and above 10 to 12 mm. we treat by therapeutic spinal puncture and repeat in twelve hours and daily thereafter until reading by spinal mercurial manometer is within physiological limit. If the reading by manometer is above 16 or 18 mm. we remove 5 c.c. of spinal fluid slowly for laboratory use only and

do a subtemporal decompression with drainage. We do not do a therapeutic spinal puncture for relief in these cases, as compression of the medulla in the ring of the foramen magnum is too serious a condition to take such chances as it may cause medullary edema and death.

Usually shortly after the operation for subtemporal decompression with drainage, the readings as shown by the spinal mercurial manometer are reduced. He did not remember seeing any choked disks in acute head injuries. If the cases having a high increase in intracranial pressure are allowed to continue without relief, they usually develop medullary edema and die. If they do recover they usually show post-traumatic symptoms both physical and mental, which are very distressing.

They do not base the diagnosis and treatment on whether or not a fracture of the skull exists except in fractures of the vault. They feel that the determination of intracranial pressure in acute head injuries is very important. Injuries to the posterior part of the vault are usually most serious as they involve the medulla with its associate serious syndrome. Should an operation be advisable they do a suboccipital decomposition with drainage.

DR. JOHN B. ROBERTS thought that "concussion" should be left out of the list of surgical conditions. Histologically, there is doubtless such a thing, but if a patient does not regain himself quickly one should look into the brain to see what is wrong by neurological or surgical means at once. He believed he had obtained good results, in obscure injuries to the head, by reducing intracranial tension by means of early venesection associated with purgation.

DOCTOR SHALLOW in closing said he did not mean to give the impression that he believed in operating in every case. Two of the cases reported were not operated on. In reference to Doctor Rodman's remarks about the size of the decompression, one can go in and stop the hemorrhage if there is any. He had seen subdural decompressions which were not sufficient and had done as many as four decompressions. One can determine the extent necessary at the time of operation. Whether pressure causes the epilepsy or not, he was doubtful, but it hardly seemed so, as in that event every case of brain tumor would have it.

These cases should be operated on within a number of hours, before they get their optic atrophy and choked discs. One might as well go on and follow the conservative treatment, if you wait for all these symptoms to develop. He thought that careful study with the ophthalmoscope was impossible in these cases. His observation is to determine at once what is the best thing to do if the patient does not come back to consciousness. If it is the quiet form of unconsciousness one can take some risk. If one does a lumbar puncture and finds hemorrhage it indicates a subdural hemorrhage.

TRANSPLEURAL ESOPHAGO-CUTANEOUS FISTULA

DR. ALFRED HAND and DR. WALTER E. LEE reported the case of L. L., two years of age, male, who was admitted to the Children's Hospital with the history of having caught cold July 4, 1922; who on examination

TRANSPLEURAL OESOPHAGO-CUTANEOUS FISTULA

presented the typical physical signs of a consolidation of both left lobes of the lung. On July 16 changes in the physical findings led to the inference of fluid being present and on exploratory aspiration, cloudy fluid was withdrawn from left base in posterior axillary line. Patient was transferred to the surgical ward July 17.

Operation under local novocaine anaesthesia. Incision in eighth interspace, left chest, posterior axillary line. No rib resection. A foul-smelling, thin, purulent material was liberated on opening into the pleural cavity, to-and-fro suction through the wound very marked. Rubber tube inserted just to the inside of the pleural cavity and fixed by silk.

After operation child did well, not seeming to suffer from any shock; hourly dressing. Drainage continued profuse, but on July 20th a change was noted in its character, it having become more profuse, and white and



FIG. 1.—Showing phago-pleural fistula.



FIG. 2.—Showing fistula closed.

flaky in appearance, having an odor of sour milk. On the following day it was noticed that immediately after the ingestion of fluids there was a more active discharge from the chest opening, smelling like sour milk. An X-ray after a barium meal showed a communication between the oesophagus and abscess cavity (Fig. 1).

The Rehfuess tube passed into the stomach was not well tolerated, although the thoracic discharge lessened. On July 24, after forty-eight hours, the tube was withdrawn on account of extreme restlessness and passed through the nares. X-ray at this time showed the left lung almost completely expanded. On July 28, after tube feeding for six days, it was discontinued because of irritation to nares and ingestion of semi-solids, but little or no liquids allowed. No passage of food through the fistula was noticed. This impression was confirmed from X-ray examination on August 12. The child rapidly improved in strength and appearance, the discharge greatly decreased and became less foul. On August 20, drainage tube removed. On August 28, a confirma-

tory X-ray showed the fistula apparently closed (Fig. 2). On September 6, discharged from hospital; incision almost healed; very slight discharge; condition excellent.

Readmitted October 18, 1922 (about five weeks after discharge). With an abscess at the site of the old thoracotomy opening, incision of which liberated a large amount of foul-smelling pus. On October 25, two ribs (eighth and ninth) were resected, and a well walled-off pocket of pus about three inches in depth was found and evacuated, which after draining normally for eighteen days closed and patient was discharged cured.

Doctors Ballin and Saltzstein, Detroit, Mich., have published a thorough and comprehensive article on this subject. They report seven cases, including their own. Since that time reports of œsophageal perforation into the trachea have been made by Forster, Miginiac, Menne and Moore; two being of malignant origin and one of rupture, the latter being due to sudden internal pressure (violent vomiting of a solid curd of milk). There was no suggestion of a preceding inflammatory condition in this case. Of a transpleural œsophageal fistula, Fonte reports one, probably luetic. Necropsy showed perforation two cm. above the cardia into the pleura. This report includes a second case, that of a true transpleural œsophageal cutaneous fistula, male adult, recovery after two years three months suppuration; several operations were performed with negative results; cure was apparently spontaneous. The diagnosis was confirmed, late in the course of the disease, by the patient tasting the fluid that was injected into the pleural cavity—probably a gastric regurgitation having first passed into the stomach through the fistula and thence to the mouth. In this case there was a history of a contusion of the left thorax two months before the pleural focus was diagnosed. Whether this had any relation to the resultant condition we are unable to state.

If one takes the various possible causes or the etiology of this condition, only two seem possible in this case, namely, acute œsophagitis and ulceration, or a tuberculous condition resulting in ulceration, and second, a local pleural inflammation and ulceration into the œsophagus. Of the above two etiological possibilities one cannot state one or the other with positiveness, but owing to the relative short time necessary to effect a cure, they are rather of the opinion that it was not of a tubercular origin.

Considering the œsophagus anatomically and remembering its relations to the trachea, vertebrae, aorta and bronchus and examining the accompanying X-ray plates, we are led to believe that our perforation occurred at approximately its second anatomical constriction, or in other words, at the point where it is crossed by the left bronchus at the level of the fifth thoracic vertebra. Here it is deviating to the left and is in contact with the left pleura. An ulceration from the pleura might well perforate through into the œsophagus. That the ulcerative process did not occur primarily in the œsophagus may be deduced from the fact that it was not until several days after operation, and considerable time after thoracic symptoms developed, that food

material was seen or suspected in the discharge. That the fistula was not caused from irritation of the thoracotomy drainage tube, may be dismissed by the fact that the tube inserted was of sufficient length to penetrate into the pleura not over one cm. Also, if the ulceration and perforation had occurred previous to operation, the drainage would have been into the œsophagus and a resultant vomitus of a pus material would have ensued; therefore we are led to believe that a local suppurative pleurisy ulcerated into the œsophagus at its closest point to the pleura, the pleura being drained through a thoracotomy opening.

Treatment.—Two main points are to be borne in mind, one, maintenance of sufficient nutrition for the patient, and second, the reinfection and constant irritation of the pleura by the traversing of the ingested food to the cutaneous surface. Of the two the maintaining of sufficient nutrition is probably the one to concern us most, providing sufficient facilities have been made to adequately drain the pleura of its infected material and food coming through the fistulous channel. The Rehfuß tube is the method of choice to overcome both conditions, but as in our case, the patient not bearing this treatment well, resort must be made to other means. Rectal alimentation or gastrostomy may be used, but the simple method of giving the more solid foods (junket, custards, etc.), providing the perforation is not large, is the least complicated and was apparently effectual. If the fistulous opening into the œsophagus is large or is at the base of a diverticulum having a wide opening, the method we used would be of little avail in overcoming the two points mentioned. The Rehfuß tube passed readily into the stomach and there was apparently no pouching or diverticulum present.

The return of the patient for drainage of the local abscess and treatment of the necrosed ribs at the site of the thoracotomy, we do not consider as part of the condition of perforation of the œsophagus, but rather a local sequela of the thoracotomy.

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BRONCHO-SUBPHRENIC-CUTANEOUS FISTULA

DR. ASTLEY P. C. ASHURST reported the case of a man about thirty years of age, who came under his care in the Episcopal Hospital thirteen years ago, with a history that about three years before he had had some venereal disease, apparently chancroids. About six months before coming under observation, he began to have pains in his back. A few weeks before admission to the hospital he had developed a cold abscess in the left lumbar region; he was admitted to the ward, put on a Bradford frame, with extension; but as the abscess did not improve, and as he had fever and other evidences of secondary infection, and as

there was no evidence of vertebral disease, it was decided to open the abscess and drain it. When opened it was found that it surrounded the kidney which appeared to be normal. The cavity extended down toward the crest of the ilium. Doctor Ashhurst thought it came from infection of the retroperitoneal tissues ascending from the genitals. The patient convalesced but the sinus remained. He was under observation subsequently in the dispensary, but after two months, as the sinus remained unhealed, some bismuth paste was injected into it, whereupon the patient became blue in the face and the paste came out of his mouth. After a few days the bismuth injection was tried again, because it was desired to find out whether it came out of his stomach or his lungs. The second time the patient was sure it came from his lungs. He apparently had a subphrenic abscess communicating in some way with his bronchus. After several injections the amount of bismuth paste which passed through to his mouth gradually diminished and the sinus healed up. One year later he was seen again with the skin lesions of tertiary syphilis, which cleared up under treatment. He appeared to be well and had no sinus. Cases of long and tortuous fistulous communications of this kind are apparently comparatively rare, and it is remarkable how insidious the disease may be in its onset and yet the patients recover with so few complications.

IMMEDIATE PLASTIC OPERATIONS IN INJURIES INVOLVING TENDONS OR JOINTS

DRS. G. M. DORRANCE AND J. W. BRANSFIELD discussed this subject by stating that in traumatic surgery, the object is to restore the injured workers to the same or some equally useful occupation. In other words, surgeons who fail to do constructive surgery are amiss in their duty towards the patient.

The experience gained in the war in debridement of wounds, primary suture, mechanical cleansing of wounds, and late plastic surgery have been of inestimable value in caring for traumatic cases.

The uniform success obtained with pedicle flaps in late cases where the infection had not entirely cleared up, led us to believe that the increase in blood supply brought to the parts, plus the pouring out of the blood spasm and lymph, might be a factor in the healing of these cases. In all events, the infection did not appear to prevent the flap from taking.

Exposed tendons or joints, especially in crushing injuries, do poorly. They are likely to become infected and later slough. Antiseptic dressings are prone to destroy the linings of joint cavities, tendon sheaths and tendons.

They are confident that they have found a means which helps, at least in part, to overcome the difficulties encountered, and have seven cases where pedicle flaps were used immediately to cover exposed tendons or joints. In all joint cases, the rules laid down by Willems were carefully observed.

The cases shown illustrated the three most common types encountered.

1. Exposed tendon and joint in a finger.
2. A palmar injury with superficial flexor tendons exposed.
3. Compound fracture with joint opened and superficial extensor tendons exposed.

All of these cases, if treated by the usual

surgical procedures, would require plastic operations later, as there was a distinct loss of skin and superficial fascia. In the event an immediate flap had not been used, marked contracture and deformity would have occurred due to the contracting cicatricial tissue. In the third case cited above, amputation of the forearm was seriously considered, as the skin and superficial fascia had been torn off over an extensive area. Tendons were exposed and the wrist-joint opened, both bones of the forearm were broken and the fracture of the radius was compound.

The technic is the same as that employed in constructive plastic surgery of the hand. An abdominal flap is raised, using parallel incisions. The bed from which the flap is raised can usually be covered by undermining the surrounding skin. (Fig. 1.)

The potentially infected hand or arm after careful mechanical cleansing, followed by the surgical removal of all devitalized tissue, is placed under the flap, the edges of which are sutured in place. (Fig. 2.)

While preparing the abdominal flaps, they have placed the injured hand or arm in 1 to 50 hypochlorite solution. Local suppuration may occur at the margin of the wound, but will respond to the usual treatment. They have not lost any tendons through infection. In none of their cases have the tendons been divided by the injury. If this had occurred, they would not do an immediate suture.

They feel confident that the method offers something worth while in preserving tendons and joints in these cases. They have not had a sufficient number of cases to recommend it as a universal procedure. Modifications of the technic may have to be made from time to time.

Conclusions.—1. In traumatic injuries with loss of skin and superficial fascia, with tendons or joints exposed, a pedicle flap used immediately appears to preserve the tendons and joints from infection and prevents loss of tissue.



FIG. 1.—Showing preparation of abdominal flap.

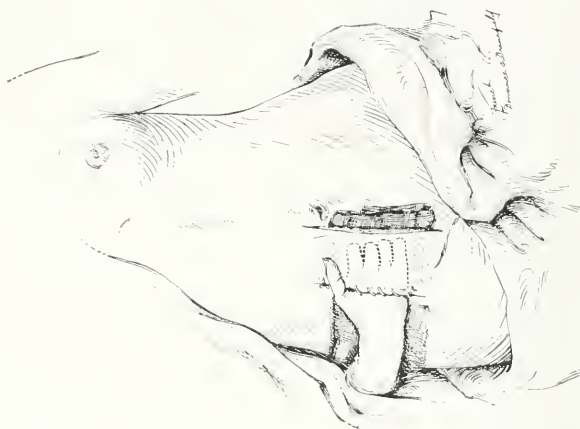


FIG. 3.—Showing injured hand sutured to flap of abdominal wall. Gauze dressing between forearm and abdominal wall.



FIG. 2.—Showing position of parallel incisions and method of undermining in order to close skin beneath flap.

2. Deformities due to scar-tissue contractures are avoided and the length of time in the hospital is appreciably lessened.
3. Traumatic injuries of this type are given a better chance for a functional result.
4. Amputation may be avoided by early plastic operation.

DR. DEFOREST WILLARD thought this idea of putting the skin immediately over the joint wound a good one. This procedure should enable one to start early joint motion in those cases where there is a considerable amount of open wound. This probably applies also to the tendons. If the tendon sheaths are still good, he thought immediate skin graft was not so important, but if open, a graft with fat underneath will be a distinct addition to the surgery of traumatism.

DR. A. P. C. ASHHURST stated that for years surgeons had turned in flaps from the neighborhood of recent wounds, where the local conditions demanded; but taking pedicled flaps from another region of the body in such circumstances is not a recognized procedure. And certainly, in the case of the woman shown, he thought as good a result could have been secured by sacrificing the two outer metacarpals, which are of no use to her anyway, and then using the skin which covered them as a flap to cover in the denuded ends of the first and second metacarpals.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held February 28, 1923

The Vice-President, DR. EUGENE H. POOL, in the Chair

CHRONIC HYPERTROPHIC VILLOUS ARTHRITIS OF THE KNEE

DR. H. E. SANTEE presented a patient, thirty years of age, male, admitted to Bellevue Hospital, August 15, 1921, who had noted four months previously a moderate swelling above and medial to the right patella which in the course of two months attained its maximum size. Never red or hot, and accompanied by very slight pain. Entire leg felt tired and heavy. Shortly following the onset of the condition, a swelling appeared lateral to the patella. Three weeks previous to admission, the joint was aspirated by a physician, and three cups of blood-tinged fluid were removed. Patient can recall no trauma as the cause of this condition.

As possibly relevant, the patient had had acute rheumatic fever in 1906, involving many joints, principally the right knee, which incapacitated him for one year. Similar attacks yearly of this swelling in the right knee, lasting a few days, but subsiding without treatment. Negative as to tonsillitis, pyorrhea, gonorrhea, or septic infection of any kind. Physical examination was negative, except for the surgical condition. The right knee-joint is markedly swollen, distending the synovial quadriceps cul-de-sac, extending to a distance of four to five inches above the patella; similar distention on either side of the patella and the patellar ligament. The joint is evidently markedly distended with fluid. Motion in the joint is painless, complete. The overlying skin shows no redness, is apparently normal. No definite points of tenderness made out except possibly over the internal cartilage. Palpation gives a slight doughy feeling, with a definite patellar click. The palate and pharynx are congested, the tonsils not visible. The heart and lungs are negative. During the stay in the hospital, the joint was aspirated, and a serous fluid obtained admixed with blood. A smear showed eighteen lymphocytes and two polymorphonuclears to the field. No organism seen. The culture was negative. A guinea-pig was injected with the fluid, and was alive after four weeks. No tubercle bacilli found in this fluid.

An X-ray of the chest on August 29 showed a small calcified area in the right lung. The teeth were negative for foci of infection. The knee-joint, No. 109954-5, showed joint spaces of moderate width, articular surfaces regular. Diagnosis, chronic synovitis. The urine was negative, Wassermann negative. Prostatic massage gave no evidence of chronic infection. Temperature normal. The patient was advised

to have exploratory arthrotomy, but refused, and accordingly was sent to the out-patient department for observation. The treatment was aspiration and a pressure bandage.

Six weeks later, in the Return Clinic, November 6, the knee showed a moderate amount of fluid. A superficial ulceration about $1\frac{1}{2}$ cm. in width marked the site of aspiration. No change in the general condition. Patient was not seen again until March 20, 1922, when he again applied to the Clinic, with the history that his knee trouble had continued. Had been working, but with some disability, due not so much to pain as to a feeling of heaviness and instability of the knee. The swelling has continued intermittently, more marked at times, but always present. Knee was aspirated two or three times by private physician. Readmission on March 26, 1922. Physical examination same as on previous admission, except that swelling extends somewhat further. An X-ray, March 30th, No. 135401-62, shows a moderate effusion in the right knee. No evidence of osteoarthritic changes. In view of continued disability, the patient desires an operation. Diagnosis here was considered in view of the previous evidence to be hypertrophic villous arthritis, with second choice as tuberculosis, mainly synovial.

Procedure.—On April 3, 1922, under gas and ether anaesthesia, with tourniquet applied, longitudinal skin incision from seven inches above patella to patellar ligament attachment to tibia, slightly external to midline, deepened to quadriceps tendon, patella and patellar ligament. Incision through quadriceps tendon and patellar ligament and a longitudinal splitting of the patella about one-half inch internal to the skin incision, the patella being sawed through. This gave most excellent exposure to the synovial lining.

Gross Appearance.—The bursal expansions of the knee-joint were the site of a chronic inflammatory thickening, the inner aspect of the bursæ and the whole synovial lining presented a reddened appearance as of chronic granulation tissue without, however, appearance of calcific deposits nor any joint mice. The joint fluid was hemorrhagic, serous in character. No erosions of cartilage were made out over the articulating aspects of either femur or tibia. About the heads of the bone corresponding to synovial attachment, the cartilaginous portions showed a small rim of rather hemorrhagic discoloration.

Beginning above the entire bursæ and synovial lining were dissected free from the surrounding tissues, first in the sub-quadriceps portion, working laterally to either side of the joint line proper, the entire synovia being removed in one piece, but with perforations where attached to bone. Joint was irrigated with saline and tourniquet removed. Hemostasis effected as completely as possible, although complete hæmostasis was not accomplished. The quadriceps tendon was then united above with interrupted chromic sutures, similarly the patellar ligament, thence a row across the anterior surface of the patella. All bloody fluid was then expressed from the joint proper as completely as possible. Skin and subcutaneous tissue closed with interrupted sutures. No drains. Dry sterile with pads about the patella so as to

produce pressure moderately about the peripatellar vacant spaces in the joint proper where dissection had been done. Moderately firm bandage.

Following the operation the patient ran a temperature from 100 to 101³/₅, with marked pain in the right knee and considerable superficial redness about the incision. On the sixth day all sutures were removed. The skin wound was slightly separated about four inches above the patella and just below. A few drops of seropurulent fluid drained out. Culture of this was sterile. Under this procedure and with wet alcohol dressings, the temperature subsided and has been practically normal since the seventh day. On the tenth day passive motion was begun in the right knee, at first limited to ten degrees, gradually increased. Beginning active motion after the seventeenth day. Up and on crutches after the third week. The small incision and opening above the patella was completely healed, the opening below the patella still exuded some pus, with slight superficial necrosis of the patellar ligament.

The specimen removed showed the synovial membrane of the knee-joint with suprapatellar bursa. The inner surface presented innumerable villi from 2 to 5 mm. in diameter. These and the membrane between were yellowish-brown in color. Adherent to these were some soft structures resembling white thrombi. Around the outside there was considerable adherent fibrous tissue. The thickened villi and synovia are built up of cellular tissue, constructive, rich in fibroblasts and well vascularized. Beneath the superficial layer are large numbers of cells loaded with golden-brown pigment in granules. Attached to the inner surface are layers of fibrin and leucocytes. No evidence of tuberculosis. Diagnosis: Chronic synovitis with overgrowth of villi and considerable pigment deposit, possibly from hemorrhage.

DR. ROYAL WHITMAN considered that in cases of chronic synovitis in which, as in this case, the granulation tissue had not invaded the cartilage, it is unnecessary to remove the entire synovial membrane as a thorough scrubbing of the interior surface with gauze seems sufficient to stimulate repair.

DOCTOR SANTEE replied that this procedure had enabled a complete inspection of the joint itself. The entire synovial lining down to the head of the tibia was removed, but in certain small parts some of it was doubtless left, though there was no evidence of this at the time of operation. There might be a question whether this patient's condition was of tuberculous origin, but this was fairly well disproved; the other possibility is a mild streptococcic origin along with the acute rheumatic fever from which he suffered in 1906.

FRACTURE OF PATELLA AFTER ARTHROTOMY

DR. H. E. SANTEE presented a second case. A male, age thirty-six, admitted to Bellevue Hospital, December 4, 1922, who three and one-half months previously suffered a dislocation of the left internal semilunar cartilage.

Operation, December 6, 1922. With tourniquet applied a longitudinal incision seven inches long was made through skin, quadriceps

and patellar ligament. Patella exposed and sawed through in line of incision just to mesial side of centre. Knee-joint exposed and flexed. The synovia looked normal. No areas of erosion of cartilage over femur or tibia. The internal meniscus was ruptured incompletely at junction of anterior third with posterior two-thirds, attached around margin. On flexion and extension of knee it would bunch up in a small mass toward the intercondylar notch. No other pathology. The internal semilunar cartilage was removed through line of rupture. Stitches were then taken with interrupted chromic gut closing quadriceps tendon above and patellar ligament before removing tourniquet. Tourniquet then removed, moderate oozing. A line of interrupted chromic sutures then taken over anterior aspect of patella, wound approximated nicely. Fascia overlying quadriceps brought together with interrupted plain gut. Skin and subcutaneous fat closed with continuous silk. Dry dressing.

Three days after leaving hospital (thirty days post-operative) patient slipped with left leg in extension. He suddenly felt excruciating pain in the left knee. Could not walk or stand. Knee became very swollen. On admission to hospital, January 5, 1923, his left knee was tremendously swollen, ecchymotic, and exquisitely tender. There was evidence of marked effusion into the joint with considerable periarticular effusion or hemorrhage. All manipulation and pressure is very painful. On deep pressure there is tenderness transversely across the patella. Div. X-ray No. 2127, taken immediately, showed complete transverse fracture of patella with some comminution. Line of fracture at junction of upper one-third and lower two-thirds. Small independent fragment external and above. Owing to marked pain and discomfort knee-joint was aspirated with removal of two and one-half ounces of thick bloody synovial fluid, with immediate relief.

Operation, January 15, 1923. A curved transverse incision with convexity downward about one-half inch below line of fracture of left patella. Dissection upward over anterior surface of patella periosteum. Line of fracture exposed with the lateral extension on either side. Small irregular tear one-half inch in extent in either lateral extension. Patella itself separated about one-half inch. Line of fracture transverse through thickness of upper one-third with lower two-thirds; independent fragment through external portion of upper fragment, but not apparently through old line of median split patella operation. Marked hemorrhage into knee-joint with old clot. Some hemorrhage into soft tissues about joint. The periosteal covering of the patella was rather thickened and edematous so that sutures, especially through the lateral portion of the anterior covering, were difficult to place without tearing out. One mattress suture—through lateral extension on either side of patella. One interrupted suture close to patella on either side and a row of interrupted sutures across anterior surface bringing the fragments in as close apposition as possible. Apposition was close throughout inner two-thirds of fracture line, about one-fourth inch separation through outer third. Fine kangaroo tendon used throughout. Skin closed with layer of subcutaneous plain gut. Skin itself closed with continuous silk.

Post-operative course uneventful. On twenty-fifth day passive and active motion instituted gradually. The peri-articular thickening apparently subsiding. Five weeks post-operative the mobilization of the joint progressing fairly well. Active motion from complete extension ranging to 80° flexion. Passive motion to practically a right angle. Hospital X-ray, 2-24, No. 28733-4, shows old fracture left patella just above middle, with some irregularity at line of fracture on articular surface and some rarefaction of fragments.

FRACTURE OF FEMUR. PLATE IN SITU AFTER EIGHT YEARS

DR. CLARENCE McWILLIAMS showed a boy, now twenty-three years of age, who sustained a simple oblique fracture of the right femur running from above down, in the middle third, eight years previously. There was shortening of two inches (Fig. 1). A Buck's extension was applied, but no amount of weight overcame the shortening. After five days under anæsthesia on a Hawley table, a plaster case applied from the sole of the foot up around the abdomen. An X-ray showed that the over-riding had not been overcome. On the eighth day a vanadium Lane plate was applied with six screws after releasing the upper outer fragment from its being imbedded in the muscle. The dove-tailing was very accurately accomplished (Fig. 2). A plaster-of-Paris spica was applied and union was by first intention. From the X-rays taken a week ago, it is seen that the plate is in good position; there is no absorption of bone about the screws nor is there any shortening (Fig. 3).

He stated that he did not remove Lane plates until there was some sign of irritation, except in case it is applied to the radius and ulna. In this situation the plate weakens the bones, and renders them more susceptible of subsequent fracture. Suspension and traction now being the standard method of treating fractures, makes Lane plates almost entirely unnecessary. Almost any fracture of the femur can be successfully handled by this method and in re-treating this patient suspension and traction would have been used. Failing to obtain good position with this method, he would cut down upon the fracture, release the bone from the muscle, and close the wound without applying a plate, using then traction and suspension. The disadvantage of a plate, outside of liability to infection, which is great, is that one must apply a plaster splint. This causes a very stiff knee which takes months to overcome. This is not the case with the suspension and traction method of treatment.

SARCOMA OF TESTIS

DR. WILLIAM B. COLEY presented a patient S. S. S., forty-two years of age, who was operated upon for sarcoma of the right testis by Dr. M. J. Seelig, of St. Louis, in 1902. A diagnosis of round-celled sarcoma was made at the University Laboratory and sections of the tumor sent to Doctor Concliman of the Harvard Medical School, who confirmed the diagnosis. The patient remained well until two or three years prior to 1919, when he had occasional attacks of cramps in the groin on the right side. It was thought at first that the condition might be due to chronic appendicitis. He went to the Mayo Clinic in May, 1918, and



FIG. 1.—Oblique fracture of middle third of femur. Shortening of two inches.



FIG. 2.—Result after open operation which consisted in releasing the upper end of the lower fragment from being caught in the muscle. Application of a six-screwed vanadium steel plate. Perfect reduction.

1085



FIG. 3.—Result after eight years.
Perfect alignment, no shortening, no
absorption of bone caused by the
screws.

their physical examination report at that time reads: "The large tumor in the abdomen is probably a recurring sarcoma, involving the deep glands along the spine. This growth apparently is not attached to any organ. General condition good." He was treated with X-ray and radium at the Mayo Clinic, under which the tumor subsided considerably. Shortly after returning to his home the tumor again began to increase in size, his abdominal symptoms recurred, and another tumor developed in the left supraclavicular region. The patient was referred to the speaker for advice and treatment.

Physical examination at this time showed a large tumor in the right lower abdomen, apparently retroperitoneal metastasis, from the primary tumor of the testicle. The left supraclavicular region was occupied by a tumor about the size of a hen's egg, apparently another metastatic growth from the primary sarcoma of the testis. Doctor Coley stated that he had seen four cases of metastases in the left supraclavicular region following a primary sarcoma of the testis. The explanation for this, no doubt, is that the thoracic duct which drains the abdominal and lymphatic glands, empties into the left subclavian vein.

The patient was admitted to the Memorial Hospital and treated with systemic injections of the mixed toxins alone. After two weeks' treatment the mediastinal tumor had diminished to one-third its original size and the tumor in the abdomen had also decreased appreciably. He was then given a massive dose of radium over the left abdomen, and a radium pack was placed over the left supraclavicular tumor. In about three weeks the supraclavicular tumor had entirely disappeared and the tumor in the abdomen had steadily increased in size. The patient then returned to his home, where the toxins were kept up for six months, at the end of which time he returned for further radium treatment. Examination then failed to reveal any tumor mass in the abdomen or supraclavicular region. Another radium treatment was given over the abdomen, and the toxins were further continued. He has come on for observation every six months during the first two years, and just once during the last year.

The patient remained well until January, 1923, when he was seized with what was taken to be an attack of grippe, with some pain in the right chest, but very little temperature. Dyspnea developed shortly afterward and increased rapidly. Two weeks later, on arrival at the hospital, his dyspnea was so great that he had to have an immediate aspiration. Two quarts of chocolate-colored fluid, slightly tinged with red, were withdrawn from the right chest. With the previous history of recurrent sarcoma of the testis, it was naturally assumed that a metastasis had occurred in the lung. The X-ray, however, was negative. Within five days the chest again filled up and dyspnea became marked. A second tapping was done and two and one-half quarts of similar sterile fluid withdrawn this time. Three other aspirations were performed at intervals of three to four days, the last one three weeks ago, on February 7th. At the last aspiration seven pints of fluid, similar in character to the earlier aspirations, were withdrawn. The lungs did not

refill after the fifth aspiration. The patient quickly regained his strength and a recent X-ray examination again shows no evidence of metastases. In view of this fact, together with the sudden onset of the trouble, immediately after exposure to the grippe, Doctor Coley stated, they felt constrained to conclude that they were dealing rather with an unusual type of pleurisy following grippe, and that the condition had no relation whatever to the patient's former malignant tumor.

DOCTOR LILIENTHAL expressed his confidence in this serum by using it, in some cases, in preference to X-ray or radium, especially in lymphosarcoma. In cases in which there are metastases, or in those of sarcoma of the long bones, he had seen Coley's fluid successful and the patients get well. Only a few days before he had received a letter from Doctor Coley telling him of the recovery of a patient referred for this treatment who had osteosarcoma of the tibia. It was *not* a giant-celled tumor. The mass had been extirpated by Doctor Lilienthal with the idea of its being non-malignant, but the pathological report contradicted this. He had felt that radium in a case of this kind would be worse than useless and had preferred to try Coley's fluid instead. That was one year and a half ago and there had been no sign of recurrence.

USE OF METAL PLATES IN THE TREATMENT OF FRACTURES OF THE LONG BONES

DR. ALFRED STILLMAN read a paper with the above title, for which see page 75.

DR. JAMES M. HITZROT thought that among the real reasons for the present unpopularity of the steel plate are the selection of improper cases for their use, and the use of plates by surgeons who did not know how to use them properly. If a plate causes trouble it is quite safe to say that it has not been put in properly. Another important point is that if a plate is used after every other method has been tried and failed and the result of the use of the plate is also a failure, the blame is placed upon the plate which is not fair. If a plate is to be used, a decision to do so should be made early. Operation upon late cases is unsatisfactory, and if plates are used infection and other troubles are more apt to occur. In the healing process, osteoid tissue, becomes fairly well established along the line of fracture between the eighth and twelfth days. If a plate is to be used it should be used before this tissue has become established, namely before the twelfth day.

He had had one death and four infections in over one hundred cases in which the metal plate was used. Most of his trouble with plates occurred in the tibia and humerus. He did not remove the plate unless there was some indication for doing so, and he had several cases which have carried plates without trouble for eleven years. Nine plates had been removed; infection one case, screws pulled out four cases (three of which were not properly applied and wood screws were used), pain in the region of the fracture two cases (in these the plates were densely imbedded in bone and

no cause for the pain could be found at the time of removal, the pain however disappeared), rarefaction of the bone in the region of the plate one case (the plate and screws lay entirely loose in dense scar tissue). One plate was removed at the patient's request. None had to be removed which he had personally applied for non-union, although in some half dozen cases in which the patients had non-union, he removed plates which had been applied elsewhere.

With regard to the complete supersedence of the use of the plate by skeletal traction, he did not believe that a plate should be used when traction or any other method would give the desired result. The plate is a special method for special cases, properly selected, and should only be used by surgeons specially trained as to the pitfalls in its application. With regard to stiffness in the joints after the use of the plates, he showed a special type of brace or splint before this society in 1912, with a ratchet at the hip and knee which allowed for motion at the knee, and he saw no reason for a stiff knee if intelligent after-treatment was carried out.

DR. HOWARD LILIENTHAL said that in the treatment of fractures absolute fixation is nearly always necessary, and there is nothing which will accomplish this better than the Lane plate, but the plate remaining in too long does do harm in certain cases. It is a foreign body. In the second place, no matter how firmly the screws fit in the bone, there is no bone where the screw hole is which is not likely to break at this point, even when the screws are in place. If the plate is taken out these holes will eventually fill with bone. The speaker described a plate which he has devised with screws which protrude from the bone and stick out of the wound. At the end of four to five weeks where there is enough fixation to hold the bone with plaster-of-Paris, the screws are removed and the plate pulled out by means of an attached piano wire. He had treated nineteen cases in this way, but the wounds in the compound fracture cases when thus plated were left wide open and treated at once by Carrel's method. He strongly urged the use of this method in gunshot wounds of the femur as the first operation. The important thing was that one had a large wound, one had performed a debridement, put in the plate, and immediately started Carrel-Dakin treatment. By iodizing these cases a possible gas bacillus getting in with the screws is avoided. In recent cases a clamp or plate should be used, but there should be metallic fixation. In compound fracture cases, the very ones in which Lane said the plate should not be used, there is less risk from using it.

CORRESPONDENCE

LYMPHO-SARCOMA OF THE TONSILS WITH CERVICAL METASTASES

EDITOR ANNALS OF SURGERY:

Sir:

The case reported below is as unusual in its pathology as fortunate in the apparent result, following extensive surgical interference and post-operative radium treatment.

A review of the literature upon malignant disease of the tonsil fails to reveal any case of cure where metastasis to the neck had occurred. Dr. M. B. Tinker in May, 1922, in a paper before the American Surgical Association, said that so far as he had been able to determine there had been no recoveries but spoke of a personal communication from Dr. E. A. Codman, in which the latter recorded a recovery from extensive carcinoma of the jaw with neck involvement after intensive radium treatment.

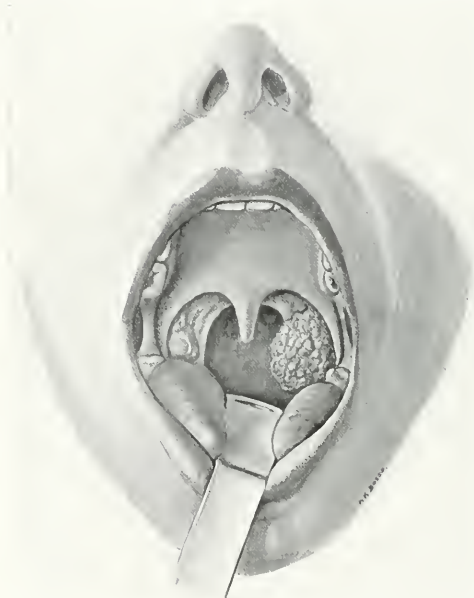


FIG. 1.—First appearance of the disease upon the tonsil.

The majority of these cases of tonsillar and pharyngeal cancer are seen so late that with the rich lymphatic drainage from the tonsil especially, extensive submaxillary and cervical extension has occurred even when the lymphatic nodes are not greatly enlarged. Hence the necessity in a dissection of the neck for malignancy that not only all appreciable disease be eliminated but that a dissection starting often as low as the clavicle should by the block method and

FIG. 2.—Line of neck incision, actually carried somewhat higher.



FIG. 3.—Neck as it appeared after removal of platysma and cellular tissue.



working wide of all suspicious areas, remove every particle of tissue but the muscles and greater vessels and nerves. Occasionally it may be necessary to remove muscular tissue, resect a jugular, or even a larger artery as in a case of large carotid body tumor reported in 1917* and who is well to-day. This procedure is not the laborious and time-consuming affair that is the usual conception, for by working well outside the limits of the disease we are in very normal tissues that dissect cleanly and freely.

Case Report.—Miss E. B., age sixty-one, was first seen by Dr. E. Foskett who referred her to Dr. A. P. Voislavsky for confirmation of diagnosis and treat-



FIG. 4.—Patient three years after operation.

ment. She was sent to Dr. Robert Abbe by the latter for radium treatment. Three months before observation she noticed the enlargement of the tonsil, her attention being called to it by a feeling of fulness in the throat and slight difficulty in swallowing. It was but three weeks before she was seen that she noticed the glandular enlargement in the neck. The right tonsil was greatly enlarged, presenting a fungating appearance. The anterior cervical chain of glands were enlarged but apparently discrete and movable. It seemed that while the diagnosis was probably carcinoma that she would stand a better chance for cure with a thorough cleaning out of the neck and wide removal of tonsil with strong post-operative radiumization. She was referred to me for operation, January, 1920.

Operation, January 5, 1920.—A block dissection of the right side of the neck from the clavicle to the superior pharyngeal constrictor muscle beneath the tonsil was first done, including all tissue except the submaxillary and sublingual glands, muscles and greater vessels and nerves. The lymphatics beneath and behind the sterno-mastoid were removed as well but at examination this group was only hyperplastic. The tonsil was enucleated by going through the anterior pillar, which had become adherent as well as the posterior, and extending the dissection into the muscles and through the posterior pillar. The pharynx was not opened, to avoid a probable and disagreeable fistulous tract, and because it was believed that radium treatment would take care of any remaining disease in the

* ANNALS OF SURGERY, 1917, p. 252.

thin septum left. The patient left the hospital twelve days after operation and combined outside and inside radium treatment was begun, the patient receiving 540 mg. hours.

Pathologist Report.—Diagnosis, lymphosarcoma of tonsil with involvement of cervical nodes.

Macroscopic Examination.—The tonsil measures 3.3x3x2.5 cm. It is uniformly enlarged and the oral surface is ulcerated rather superficially. The color of the nodes normal but show a soft cellular structure, without any evidence of fibrosis. The capsule is intact posteriorly. There is a greatly enlarged soft cellular cervical node resembling in color and consistency the tonsil.

Microscopical Examination.—Sections of tonsillar tumor show a very large cellular growth partially covered by a thin layer of squamous epithelium, but without the characteristic deep crypts of the normal tonsil. The normal markings are also obliterated by the cellular growth and germinal centres cannot be seen. The predominating type of cell is a large one with a rather large pale nucleus, much the type of those found in the germinal centres of lymph-nodes. There is no intervening stroma between the cells, but short hyaline fibrous trabeculae are not infrequent. Small blood-vessels are found within these. Mitoses are fairly numerous. The muscular fibres in contact with the posterior surface of the growth have been considerably invaded, showing that the growth is not limited by a capsule. In these locations the muscle fibres are small and nearly atrophied. Sections of the large node show the same type of growth. Other smaller nodes show chronic inflammation without metastases. The growth appears to be a lymphosarcoma of the type originating in the lymphoid tissue and is evidently malignant judging from its invasive quality.

Six months after operation, this patient again felt the sensation of a lump in her throat but this time on the left side, and had gradually increasing difficulty in swallowing. She noted an enlargement of the left tonsil. Two months later (eight months after the operation) she presented herself with an exact counterpart of the original condition which had existed upon the right side. Cervical glands had been noticed three weeks before. The left tonsil was greatly enlarged



FIG. 5. Patient three years after first operation and two years and four months after second operation.

and showed the same cauliflower growth. Exactly the same operative procedure was carried out upon the left side, September 20, 1920, eight and one-half months following the first. The patient left the hospital fifteen days after the operation and again received radium treatment.

The second report of the pathologist is a duplicate of the first. Diagnosis, lymphosarcoma to tonsil and cervical nodes. Microscopical examination—sections of the tonsil show none of the normal follicular arrangement but a diffuse growth of rather large round cells somewhat resembling lymphocytes and occupying the position of a tonsil being still covered in some areas with stratified epithelium. There is only a very delicate stroma which carries the blood-vessels and the cells are arranged diffusely and form a very cellular tissue, the type of a lymphosarcoma. The smaller lymph-nodes show also the same type of growth as the nodal structures are obliterated in these also.

Whether we are to regard the reappearance of the disease in the left tonsil as a metastasis or as a recurrence, in the sense that Dr. Ellsworth Eliot † speaks of, is uncertain, but I decidedly incline to the belief that it was an independent occurrence of the disease in similar tissue due to the same unknown etiological or causative factor that produced the original, notwithstanding the very short interval that elapsed between the two appearances of the disease. The patient is a woman of exemplary habits and mode of life and there is nothing in her family or personal history suggestive as a causative factor in her disease. She is well to-day, her wounds both in neck and throat scarcely appreciable, and she appears in perfect health. No visceral involvement or other glandular enlargements have occurred at any time. Notwithstanding the extent of the surgical removal, I believe that radium played an important part in her recovery.

W. S. SCHILEY, M.D.,
New York, N. Y.

ACUTE INTESTINAL OBSTRUCTION CAUSED BY CHRONIC ORGANIZING PERITONITIS OF UNDETERMINED ETIOLOGY

EDITOR ANNALS OF SURGERY:

Sir:

Dowd of New York has recently reported a case of acute intestinal obstruction due to extensive peritoneal adhesions. This so closely resembles a case we have recently seen and is apparently so uncommon that we believe it of sufficient interest to put on record.

Case Report.—Hospital number 248302. A. P., a white male, age twenty-two, a private in the C.A.C., U.S.A., was admitted to Ancon Hospital at 9.55 P.M., November 6, 1922, with the following letter from his medical officer. "This patient was first seen about 4.30 P.M. today. Complained of considerable pain in lower abdominal region. No rigidity, no tympanites, no nausea or vomiting, and no temperature. Was given hypo of $\frac{1}{2}$ gr. morphia, dose of castor oil, and admitted to post hospital. No pain or tenderness over region of appendix. Seen again at 9.00 P.M., apparently in considerable pain, some nausea and vomiting, and

† ANNALS OF SURGERY, September, 1922.

considerable rigidity with some tympanites. Skin moist, pulse rapid, no elevation of temperature. Looks like an acute surgical abdomen."

The patient's statement on admission was that while on sentry duty about noon today he developed a colicky pain in his abdomen. This became worse and at 2.30 P.M. he fainted and was carried to the guard-house by his prisoners. He does not remember having had the diseases of childhood and emphatically denies any previous abdominal trouble. He was apparently in very severe pain in spite of his large dose of morphine and was rolling on the bed and crying when seen on admission.

Physical findings were as follows: His face showed his intense pain and the expression was one of anxiety. Vomiting was occurring practically continuously. His abdomen was markedly distended, rigid, and tender. His temperature was 97.2°F., pulse 60, small and easily compressible, and the skin moist and clammy. A provisional diagnosis of ruptured gastric or duodenal ulcer, or some type of acute obstruction was made and patient prepared for immediate operation.

Operation.—Ether anaesthesia. A long incision through the right rectus muscle was made, extending from the costal margin to well below the umbilicus. An increased amount of cloudy peritoneal fluid was noted and the incision was immediately filled with markedly distended congested small intestines, but were prevented from eviscerating by a mass of veil-like adhesions of varying density which completely involved both small and large gut. These adhesions seemed to bind the intestines into a mass, and at least ten or twelve areas were noted where complete obstruction had taken place. The large intestine was distended to the sigmoid flexure, the rectum was empty and practically collapsed. The adhesions seemed to be of increased density at the caecum, the hepatic, splenic, and sigmoid flexures, while those involving the small intestines varied from thin veil-like adhesions of apparently recent origin that were easily separated with the fingers, to denser bands that required cutting with scissors and ligating. The appendix tip was adherent to a loop of small gut and at first sight suggested a fistulous tract opening into the intestine, but further investigation showed it to be only adherent. There was no evidence of acute inflammatory conditions, tubercles, or neoplasm. The mesenteric glands appeared enlarged and hard, and one was excised for examination. The appendix was removed for examination as to etiology.

Beginning at the ligament of Trietz, the entire small intestine was freed by cutting the adhesions with scissors. The denser adhesions around caecum and flexures were cut and ligated as fairly large vessels were encountered. Finally an enterostomy was done in the mid-portion of the ileum where the most distention and intra-intestinal fluid was noted, a rubber tube inserted, and the intestine sutured to the peritoneum and abdominal wall. The entire operating time was one hour and fifty-six minutes; the pulse had remained between eighty and ninety per minute, and grave doubts were experienced that we had done the patient any great benefit on account of the probability of immediate recurrence of the adhesions.

Post-operative.—Patient was given 5 per cent. solution of glucose and soda bicarb., oz vi every 3 hours by rectum, and morphia hypo as required for restlessness. He was allowed limewater on cracked ice by mouth as soon as he came out of his anaesthetic. Convalescence was stormy for the first five days on account of abdominal distention and vomiting. This was relieved by enemata, pituitrin and gastric lavage, and the drainage from the enterostomy tube became well established. On the third post-operative day he had a liquid stool by rectum. Daily enemata were used to stimulate intestinal peristalsis and to decrease the discharge from the enterostomy tube, which amounted to about oz.xx in twenty-

four hours. This tube was removed on the eleventh day and the fecal discharge soon excoriated the skin in spite of the zinc oxide ointment used. This was further complicated by quite a profuse hemorrhage from the border of the enterostomy opening on the fourteenth day, but was readily controlled by packing. About this time he was put on a special soft diet, having been on liquids up to this time.

From this time his convalescence was satisfactory, his enterostomy discharge gradually decreased, his bowels moved naturally, and he was allowed up as soon as his strength permitted. After the thirty-seventh post-operative day the daily enema was discontinued and he was given cascara and senna mixture every evening. His bowels moved regularly, he regained all lost weight and had no further abdominal symptoms. The enterostomy wound closed without further operative measures and he was discharged from the hospital on January 10, 1923, sixty-five days after admission.

He has been seen twice following his discharge from the hospital, the first time following a thirty days hike into the interior of Panama, and appeared to be in perfect health and was entirely free from any symptoms relative to his previous condition. He reported by request on April 20, 1923, for examination. His wound was firmly healed without sinus or hernia. He stated his bowels were regular, and that he had no recurrence of symptoms, however slight, since leaving the hospital. He was at normal weight and doing full military duty.

The pathologist reported as follows: Appendix negative. Gland shows moderate amount hyperplasia of reticular tissue. No evidence of tuberculosis, syphilis or tumor. The Wassermann blood test was negative.

HOWARD K. TUTTLE, M.D.,
Ancon Hospital, Canal Zone.

DIET AFTER GASTRO-ENTEROSTOMY

EDITOR, ANNALS OF SURGERY:

Sir:

I note that in the *Lancet*, March 31, 1923, under the heading Treatment of Duodenal Ulcer, a distinguished surgeon in the menu which he gives to all his gastric and duodenal cases for their guidance after operation mentioned "*Meat Cooked a Second Time*," "*Boiled Milk*," and "*Brushing the Teeth, Gums and Inside of Cheeks*" a few times daily.

As to the first I have little to remark further than to state that I prefer meat "cooked to a turn," i.e., juicy, tender fle h which dissolves in the mouth during mastication, I consider over-cooked meat, all the sap of which remains in the oven, on a par with cooked timber, absolutely useless as a food, and after long experience in this land of meat eating, I have been forced to the conclusion that it acts as a foreign body and as such is a fertile source of cancer of the stomach.

As to the second, I am a believer in the dictum "*Boil Milk and You Spoil Milk*," and consequently order fresh milk when it can be obtained from a healthy cow. But if any doubt should exist as to the latter I recommend scalding. Always with primary scalding of the vessel in which it is about to be retained. In many adults there seems to be an extraordinary repugnance to milk—which boiling usually intensifies—a dislike which I can only explain

by the difficulty they find in digesting it. This may be alleviated by the addition of barley or mineral water and a few grains of citrate of soda. In suitable cases a teaspoonful of whiskey to each glass of milk is a helpful combination. I never permit milk to be taken with a meat meal.

As to the last quoted item, *viz.*, "Brushing of Teeth, Gums and Cheeks," I have no experience of "brushing" of the two last mentioned, but I have had an extended one of the brushing of teeth and, rightly or wrongly, have come to the conclusion that a large percentage of human suffering (*e.g.*, pyorrhoea, dental caries, gastric infection, appendicitis and organic decomposition in general) is caused by the inane daily scrubbing of teeth by bristles and by the insane use of chemical dentifrices, both of which lacerate and mortify living tissue, destroy epithelial defence and provide the entrance for hostile germs. I earnestly invite the attention of my readers to the handicap which this kind of thing imposes on natural disinfectants, saliva and mucus. I do not think that there is a human being to be found outside a mad-house who would advocate similar brushing, *etc.*, of the interior of the anal canal. If such a hygienic enthusiast can be discovered, and he makes a hobby of it, I am prepared to lay him a shade of odds that in nine instances out of ten the immediate result will be proctitis plus toxæmia, and that the ultimate one will be cancer.

In making above statements I do not wish it to be inferred that I disapprove of cleansing the teeth at bedtime, on the contrary, a *gentle cleansing* with a soft (badger hair) brush and some ordinary soda or other effervescent potable water is an unirruting and salutary procedure, and I can personally vouch as to its being an effective and agreeable one.

As to disinfection of the gums and buccal mucous membrane, I insist that the job appertains to the natural scavengers and that artificial meddling with their work is as insensate as it is destructive. *In Other Words do not Put Anything Into Your Mouth that You Would be Ashamed to Put Into Your Stomach.*

JOHN O'CONNOR,
Buenos Aires, Argentina.

OSTEOMYELITIS OF THE SPINE

EDITOR ANNALS OF SURGERY:

Sir:

A considerable number of cases of osteomyelitis of the spine have been reported, some as early as 1833. Donati (*Archiv für klinische Chirurgie*, 1906, vol. lxxix, p. 1110) reports fifty-five cases and one of his own. Plenz (*Deutsche med. Woch.*, vol. xlvii, p. 416, April, 1921) could find records of sixty-two cases of acute osteomyelitis to which he added three cases. In somewhat more than half the cases the disease involves the vertebral body alone; sometimes only the neural arch is involved; sometimes both arch and body are affected. Osteomyelitis of the spinous process alone is unusual.

Such a case is herewith recorded. We have found no other case in a search of the literature.

Acute osteomyelitis of the spine, due most frequently to the staphylococcus, is a disease of youth. Most of the cases come in the period from the tenth to the twentieth year. However, a case of acute osteomyelitis has been recorded in a three weeks' infant. (J. Madier Nonrissou, vol. x, p. 168, May, 1922.) Like Pott's disease it most frequently affects the most mobile part of the spine, the lumbar region. Twenty of Donati's fifty-six cases are lumbar. Trauma and infection elsewhere play a part in the etiology of the disease as in osteomyelitis generally. The mortality according to Whitman (Orthopedic Surg., 6th Ed., p. 114) is 56 per cent. Kyphosis does not follow recovery.

It is a disease of sudden onset, rapid abscess formation and great tenderness. The spinal canal may be invaded. Paralysis and death can occur without rupture of the dura as in Braunlich's case (J. A. M. A., vol. lxviii, p. 347, February, 1922). The abscess tends to point anteriorly where the body of the vertebra alone is affected, and posteriorly where the neural arch is concerned. Simple incision and drainage are demanded where the arch is involved. Laminectomy may be necessary where the disease is confined to the body. Occasionally more than one vertebra may be affected.

Katie Klimo, L. H., 90667, age ten, entered Lakeside Dispensary on June 13, 1922, with the complaint of lame back. The illness began a week previously when the patient fell on the school steps, striking her back. There was little pain or disability and the patient continued at school for two days. Two days before admission she became feverish and complained of great pain in the lower back, so that she could not walk or stand and cried with pain when moved in bed. Examined in the dispensary her temperature was found to be 38.6° C. There was marked tenderness in the mid-lumbar region with spasm of the lumbar muscles. Motion was not permitted. There was no swelling and no fluctuation, but a little heat. This, together with the elevation of temperature, seemed to rule out a simple sprain or fracture. The process was too acute for Pott's disease. The diagnosis of osteomyelitis of the spine was made and the patient was sent into the hospital. X-rays of the spine were negative. The patient ran a septic temperature with little change in the condition of the back. On June 22nd the temperature rose to 40 degrees C. On that day an incision was made over the spinous processes in the mid-lumbar region. A pocket containing several ounces of pus was encountered and evacuated. The spinous process of the third lumbar vertebra was rough and without periosteum. The incision continued to drain. On the 30th the incision was enlarged and the spinous process of the third lumbar vertebra removed. The rest of the vertebra and the adjoining vertebræ seemed normal. The incision gradually closed. The patient was discharged well on July 16th.

The patient was seen January 27, 1923. The incision was healed. There was no tenderness. The back motions were normal. X-ray showed no regeneration of the spinous process that had been removed.

GEORGE I. BAUMAN, M.D.,

RICHARD E. STIFEL, M.D.,

Cleveland, Ohio.

THE QUESTION OF DRAINAGE IN INTRA- ABDOMINAL INFECTION

EDITOR, ANNALS OF SURGERY:

Sir:

In the May, 1923, issue of ANNALS OF SURGERY, there appears an article by Wilensky and Berg on "A method for determining the question of drainage in intra-abdominal infection." They quote no previous workers along this line of study. I feel sure they would be interested in an article written in 1912 by Wilkie of Edinburgh (*International Clinics*, 22, vol. iv, pp. 145-153), in which this subject receives rather thorough attention.

Wilkie's subject was "The prognostic value of an immediate examination of peritonitic exudates," and rather early in the discussion he makes this statement: "* * * The film can usually be stained and examined long before the surgeon has completed his work, so that he may also have the benefit of such accurate information as it affords in deciding the question of drainage."

The article is beautifully illustrated with color drawings of the various typical fields in fatal and non-fatal cases, as determined by the type and number of bacteria present and the degree of phagocytosis. In other words, Wilkie goes deeper into the problem than do Wilensky and Berg, and in speaking of phagocytosis as revealed in the stained film, he says "* * * the important point for the surgeon and patient is not the name and cultural characters of the invading germ, but its relative virulence for the particular individual."

There was a revival of wound-study by means of smears during the recent war, and I have personally availed myself of every opportunity to study wounds by Wilkie's method since reading his article.

Within the past year, my colleague Doctor Voeglin and I have presented the results of a study of wounds in general, in an article in *International Clinics*, 32, No. iv, pp. 281-295. I am thoroughly in accord with Doctors Wilensky and Berg in their endeavor to popularize a method which has proven valuable because of its simplicity, the type of information it conveys to the surgeon, and the speed with which the information is forthcoming.

It is to be hoped that in the studies which Wilensky and Berg are continuing, some note will be made of the degree of phagocytosis, etc., in order that their next report will either confirm or refute the theories of Wilkie and others in this field of study.

EDWARD P. HELLER, M.D.,

Kansas City, Mo.

BOOK REVIEWS

LAWSON TAIT, HIS LIFE AND WORK. By W. J. STEWART MCKAY. 8vo, pp. 579. New York, William Wood and Company, 1922.

Lawson Tait died in June, 1890. Most of his contemporaries, with so many of whom he waged acute controversy almost up to the day of his death, have already followed him to the grave. Among the new generation, which now occupies the stage of action, his name remains as that of a leader and a pioneer in regions of surgery which since his time have become among the most common fields of surgical endeavor, and out of which some of the greatest rewards of such endeavor are constantly being secured by every surgeon. He had a rare personality, an intense conviction of the truth of the conclusions to which his observation and reasoning had led him, and a vigorous and defiant readiness to override any opposition he might meet in the advocacy of his views. His two *bêtes noir* were Mr. Lister and Mr. Spencer Wells. This hostility was as much temperamental as it was scientific in origin, for one cannot imagine a greater difference in personality than that which distinguished these eminent contemporaries from the impatient bellicose master surgeon of Birmingham. The manner in which Lister did his work was entirely the opposite of anything that Tait could conceive or undertake. But both did a great work, although that of Lister was of far the greatest fundamental importance, and furnished the basis upon which the teachings and methods of Tait were elaborated and perfected by others until they became the common property of humanity.

Doctor McKay has performed a good work in preparing this record of the life and work of his old master. Those surgeons who knew Tait and still remain will welcome the book, bringing back to them the memories of issues and controversies of their younger days, which they now look back upon with interest and tolerance and a juster appreciation of respective merits than was possible in that former day. To the surgeon of the twentieth century it will introduce one of the most picturesque figures of the surgical world of the nineteenth century, in whose career much of instruction may be found, and to whose character and merits and achievements lasting honor should be given.

By 1884, Lawson Tait had reached the climax of his fame and his influence, although he had not reached the fortieth year of his age. He was only fifty-four when he died. It was my own good fortune to get a good view of his personality at that time. Spending some time in London in March of 1884, I wrote him asking the privilege of going to Birmingham and seeing his work. A day or two later, at my lodging in Craven Street, near the Strand, late in the evening, after I had begun to get ready for bed for the night I was summoned to the entry hall below by word that a gentleman was

waiting there to see me. My visitor announced himself as Lawson Tait! I had that very morning received a note from him in reply to my letter informing me that he was shortly to be in London to operate and that with the permission of the physician whose patient it was that he was to operate upon, he would like to have me present. Now he had followed his letter by this personal call at that late hour to apprise me of the place and hour the next day when the operation was to take place! Such a personal midnight visit to an entire stranger was a fair example of the impetuosity and directness of his character. The following week I was his guest in Birmingham. The "close up" view which I now had of Mr. Tait increased greatly my appreciation of his talents and my admiration of his work. The photograph shown in Plate IV of McKay's book represents perfectly the Lawson Tait of that day, Tait at his best. I have the same autographed photograph which was given me by Tait when I bade him good-by in 1884. I did not see him again until 1892, when we both were in attendance at the meeting of the British Medical Association of that year. Then the effects of the disease that had begun to sap his vitality were already evident. We could wish that the earlier photograph which more truly represents the real man had been chosen for the frontispiece of this book rather than the one which has been placed there which is the one that was published in the Medical Journals at the time of his death, and which presents his visage in his closing years as altered by disease and prolonged suffering. Tait was most cordial in his reception of his American colleague. They were of the same age, and the evident appreciation and admiration shown by his trans-Atlantic visitor was not disagreeable to the Birmingham surgeon. Over the "walnuts and wine" he spoke freely of many things. Tait was a great admirer of his old Edinburgh teachers, Syme and Simpson, and most appreciative in his expressions as to the work of Marion Sims (he dedicated his work on Diseases of the Ovaries to Sims). He referred also in terms of deep indignation to the conduct of certain visiting surgeons who had come to him and, after having been shown every courtesy, had been guilty, after their return home, of publishing unfounded criticisms and erroneous statements as to his own personality and methods. To a surgeon like myself who had known what the surgery of the pelvis had been before Tait had fished out the Fallopian tubes from the Serbian bog of pelvic cellulitis and parametritis in which they had been concealed up to his time, the importance and the originality of his teachings were clearly apparent. I fully agree with the statement of his biographer (p. 135) that "if we were to single out the one subject upon which Tait's future permanent fame will rest, we would not hesitate for a moment in selecting his original work in establishing the surgery of the Fallopian tubes as the greatest achievement of his life. Nothing that he ever did gave rise to so much criticism and opposition. Even the very existence of diseased appendages was denied, and his opponents did not hesitate to use terms about Tait which left their hearers in no doubt that they looked upon the provincial surgeon as nothing more

than a liar." Pelvic surgery has travelled a long way since Tait removed his first pyosalpinx in 1879 and met with such open skepticism as to his work.

The surgeon of the present day who undertakes pelvic surgery with its problems so fully worked out and its methods of treatment so fully established and its record of successful achievement so long and encouraging, ought not to forget who was the pilot that first led the way into the field of endeavor into which so many now fearlessly crowd.

After 1890, the original work of Tait may be said to have come to an end. His energy was largely exhausted in the effort to cope with the advancing kidney disease which had fastened upon him. He made no new discoveries; he dropped out of public view, and he found a retreat in his country home, although he still came up weekly to Birmingham for consultation and to operate. From time to time he contributed brief articles and letters to medical journals, largely controversial in character. One of his last contributions was a reply to a colleague on the mortality of operations on pus tubes! At three o'clock on the afternoon of June 13, 1890, he died at his home.

Mr. McKay has brought to his task as biographer both enthusiasm and knowledge. He was Mr. Tait's assistant in 1891, when the latter was still actively at work. He has given us in this book an exceedingly interesting and instructive story of a great but eccentric man. It is an account that will endure. It should be read by every surgeon who is interested in the history of his science and in the personality of the men who have made it what it is.

LEWIS S. PILCHER.

THE FORM AND FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM, by FREDERICK TILNEY, M.D., Ph.D., and HENRY A. RILEY, A.M., M.D., New York, 1923. Paul B. Hoeber.

A new edition of this treatise in two years indicates the appreciation of high scientific work in this country. Merely corrective changes appear, with no increase in bulk.

The aim of the authors, to apply the accumulated knowledge of anatomy, morphology and function to the problems of practice and the interpretation of morbidity, is carried out with a thoroughness that evokes admiration. The book has already attained the position of an authoritative American text.

It has many features of interest. In conception and scope there is much of novelty. Its size, pp. 1019 royal octavo, permits adequate handling of the subject. The concise summarizing of syndromes, a modern development in typing disease, makes the volume doubly valuable to any physician for reference. Diagrams, cuts and colored figures are admirably illustrative. And a useful glossary is appended. The book is so infused with technical terms and latest isms, that it should be a source of delight to the neophyte no less than to the scholar and worker.

As it is not primarily a system of nervous diseases such diffuse conditions

as meningitis, encephalitis, hydrocephalus, Korsakoff's syndrome, etc., evidently are not available in applying its teachings.

The inevitable slips, lapses and limitations are more interesting than important. A couple may be mentioned.

It seems impossible to carry out such a comprehensive handling of a large field without many duplications of statement. While this may serve to integrate, it considerably expands that which needs no padding. And if scissors-secretarial work happens to be included, there is a tendency to overlap rather than harmonize material.

A nominal inconsistency, that might bear elucidation, appears in reference to athetosis. On p. 815, "The dominance of the neokinetic system becomes defective" and "the infant thus affected soon presents a voluntary paralysis." Yet in a case of double athetosis, from a lesion beginning in early life, there is noted, p. 824, "The absence of any signs referable to the neokinetic system" and "the absence of paralysis or any evidence of involvement of the pyramidal system."

Consciousness and its disturbances, aside from self-consciousness, appear to be dismissed, p. 905, with the remark that "It is of little profit to rehearse the many theories of consciousness and its origin." This may be true, but it does not apply to consciousness as an objective reality or to the study of its clinical significance. For this purpose many facts are clear and admit of intelligible statement. Such terms in common use, as coma, narcolepsy, lethargia and even sleep, show that consciousness and its modifications are matters of large clinical importance. In reality neurologists make good use of these in both general localization and differential diagnosis.

No account is taken of the central canal of the cord, beyond a simple mention, nor of the work of Kramer of Cincinnati, in showing the frequency with which it opens below and its importance in such cases to surgical procedures or possibly to infections.

In a book of facts the inclusion of many probable functions and relations is a trifle disconcerting, especially as in the past so many such have gone to the discard. Or, *e.g.*, "the primitive emotion of parental feeling, probably arising first in the thalamus." The work of Mills indicates that this applies only to the right thalamus or its vicinity (in the right-handed).

It is doubtless too much to expect great accuracy or detail regarding the local circulation. And as no attempt is made to apply this part by cases, it is not clear what advantage was to be expected from including it.

Any slight blemishes, however, may serve, like "fascinator" on a girl's complexion, to bring out its quality. For clearness of expression, roundness of diction and logical consecutiveness the work can long be held as a guidon. Few have the qualifications to handle all the phases included, and still fewer the requisite energy. It is massive in every way. And the publisher's side is done with equal elegance.

WILLIAM BROWNING.

ENLARGEMENT OF THE PROSTATE. By JOHN B. DEEVER, M.D., LL.D., Philadelphia, 1922. P. Blakiston's Son & Co.

It is of interest to note that the author since the publication of the first edition of his work on this subject has materially changed his viewpoint as to the treatment of prostatics, and now advises prostatectomy as a primary rather than a secondary resort, feeling as has long been contended by others that it is by far safer for the patient than the employment of any palliative measures.

The technic of prostatectomy has indeed become so exact that the operative risk has been relegated to a position of much less importance than formerly, and stress has been properly placed upon the pre- and post-operative treatment. Statistical studies are quoted showing the effect upon the prognosis which proper preparation and care has upon these cases.

The most important question and possibly the most difficult to properly convey to the reader is that dealing with the proper time to remove the gland after preliminary drainage. Indeed it is in many instances only to be determined by personal judgment rather than by absolute laboratory test. The author tends to be guided by the patient's general condition rather than by the phthalein determination, although the increased seriousness of a falling output and a rising blood urea is fully taken into consideration.

The chapters on diagnosis, prognosis and the treatment of complications are most instructive and may be thoroughly studied with much benefit; all the essential tests and their relative value are definitely stated.

An exhaustive resumé of the various operative procedures employed is given, including the technic of suprapubic prostatectomy as advocated by Pilcher, Judd and Squier, while the perineal route as done by Proust and Young is given ample space. All methods are excellently illustrated, as indeed are all phases germane to the text throughout the book.

JAMES T. PILCHER.

TREATMENT OF FRACTURES. Reports of the Committee on Fractures of the American Surgical Association for 1913, 1914, 1915, 1916, 1917, 1918, 1921. Edited by J. F. BINNIE, M.D., and JOHN H. JOPSON, M.D., Records of the Association, and JOHN B. ROBERTS, M.D., and WILLIAM L. ESTES, M.D., Chairman of the Committee. Published by the Association, 1922.

The appointment of a special committee of the American Surgical Association in 1912, for the study of fractures, was an outgrowth of the revival of interest in this subject to which a number of factors contributed. Among the most important of these was the work of Sir W. Arbuthnot Lane, who was largely responsible for the introduction of what might be properly styled the "operative era" in fracture surgery. Lane's visit to the United States in 1909, Harte's Presidential Address before the Association in 1911, and a symposium on fractures in 1912, led up to the appointment of the Committee on Fractures in 1912. This committee, with slight change in personnel, continued its investigations until 1921, when the final reports were received.

These reports, tabulated along certain lines, with special chapters by individual members of the committee on regional injuries, and a chapter on fractures in war, are gathered together in the volume under consideration. During the period mentioned, the committee broadened its investigation as the study of fractures progressed. The original resolution of the Association charged it with the task of preparing a statement as to the relative value of the operative and non-operative treatment of fractures of the long bones (closed and open), along with a formulation of opinion of the value of radiography as a means of determining the choice of method of treatment. Its first report was therefore directed toward these aspects of the subject. Other subjects subsequently included were on the legal responsibility which the use of the X-ray involved, the fixing of standards for determining the length of disability which might be expected after fracture of the various bones, the percentage of total disability in different fractures, the relative value of certain special forms of non-operative treatment, the treatment of compound fractures, and the most favorable times for operative intervention. The irregular and oftentimes incomplete methods of recording salient points in the case histories studied, led to the preparation of a special form for the recording of histories of fracture cases. This form has been adopted by the Association, recognized by the American College of Surgeons, and adopted by many hospitals throughout the country.

The original committee consisted of Dr. John B. Roberts, Chairman; Drs. W. L. Estes, Thomas W. Huntington, Edward Martin and John B. Walker. Doctor Roberts resigned from the committee in 1915. Doctor Estes became Chairman, and Dr. A. P. C. Ashhurst became a member. The tabulation of results is based on more than 2000 cases of fracture in civil life, and over 6000 cases in military practice. The latter group are the subject of a special chapter by Dr. J. B. Walker.

During the eleven years which have elapsed since this committee began its work, the interest of surgeons generally in this special field of traumatic surgery has increased rather than waned. The great importance of the subject, in view of the general adoption of Workmen's Compensation laws, has been a contributing factor. The quickening interest of war, always a stimulant to progress in acute surgery, has had a great influence. The introduction of new methods of treatment and the revival of old and forgotten methods during the long period of strife, has led to a revision of opinions which had, under Lane's influence, become fairly fixed. It was fortunate that the committee did not conclude its work until these new methods had been at least in part evaluated. We are in a position today to contrast our present results with those of fifteen years ago, and this report will be welcomed by surgeons generally who are called upon to supervise fracture services, and to direct the treatment of fractures.

It is the fashion of the day to dwell upon standardization. To many this emphasis has become distasteful. Individual preferences in the line of treat-

ment are often based upon a habit of mind and practice, an unusual experience, or a peculiar skill, and are amply warranted. There are certain broad underlying principles, however, which should be familiar to all. A study of many cases and the conclusions founded upon such a study by a group of men of broad experience, such as constituted this committee, forms a solid foundation on which the individual surgeon may build as his experience and peculiar qualifications justify.

LEWIS S. PILCHER.

ORTHOPEDIC SURGERY. JONES AND LOVETT. William Wood Co., New York, 1923.

The eminence of the authors, is sufficient to assure the masterly treatment of orthopedic surgery, a subject which has been the life work of both. This surgical treatise of 681 pages, takes up the affections of joints; the affections of bones (including malunited and ununited fractures); disturbances of the neuro-muscular mechanism; congenital deformities; static and other acquired deformities, together with details of apparatus.

The varied subjects, under these several headings, are considered in a methodical manner and many are prefaced with excellent notes on the surgical anatomy of the parts to be considered. The volume is replete with illustrations, each of which is well chosen. The descriptions of operative procedures are comprehensive, and an attractive feature of this work is the apparent care used in appending bibliography, making it easy for the student who desires further details, to consult the source.

The literary style is commendable, and the text, for a first edition, is remarkably free from typographical errors. Throughout the work, constant reference is made to basic principles and yet due emphasis is given to important details. The authors frankly admit, in the preface, that no attempt would be made to make the work encyclopedic but the reviewer is impressed with the mass of subject matter which surely cannot be found in any other text-book, at least in the English language.

This book contains an infinite amount of knowledge, for which every physician has a constant need. The general surgeon will find it invaluable and the orthopedic surgeon may well consider it a fitting tribute to his specialty from two individuals whose efforts have done so much to advance this branch of medical science.

DONALD E. McKENNA.

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REPAIR OF THE COMMON BILE DUCT*

By LEWIS L. McARTHUR, M.D.

OF CHICAGO, ILL.

FOLLOWING a precedent early established in this Association, the Chairman's address has involved the presentation of some living problem of surgical interest. Permit me this morning, therefore, to invite your consideration of the still debatable question of Common Bile-duct Repair. My remarks will be accompanied by some X-ray photographs illustrative of the method advocated. Several years more experience with a procedure advocated by me elsewhere, serves to confirm the speaker's convictions—that while not yet perfect, it offers the most rational and efficient method yet devised for the correction of these most distressing complications in bile-tract surgery, stricture, or loss of continuity. Disease, accident, or neoplasm may result in such stricture or loss of continuity of this duct as will compel efforts on the part of the surgeon to reestablish a permanently patulous channel for the free flow of bile to the duodenum or the stomach. The procedure is necessarily modified by the causative factor in its destruction, the location of loss of lumen, and the condition of the surrounding field of operation. Unfortunately, it occurs so much more frequently as a sequel to former surgical invasion of the bile tracts for disease and resultant stones, that a certain stigma rests upon the surgeon, though generally unmerited.

Search through the literature reveals many methods that have been suggested for the relief of this condition, the majority affording only indifferent success. Ell-worth Eliot has made a masterly review of the entire subject. Here, in the home of bile-duct surgery, *particularly* must attention be called to the recommendation of Dr. William Mayo, who has successfully reconstructed the missing portion of the duct out of a tongue-like flap of all three layers of the adjacent bowel or stomach, converting it into a tube: its free end has been sutured to the proximal end of common duct, and the opening in the hollow viscus closed as thoroughly as possible about the base of the pedicle. Walton has made similar recommendations, and finds no harmful effects when using the stomach as the site of drainage. Hertzler has utilized a portion of the gall-bladder, so cut as to supply a tubular flap to repair duct; but the gall-bladder is usually absent in cases requiring repair, and when present can be more simply used by an anastomosis with the duodenum direct, thus making a by-pass for the bile.

* Presidential address, delivered before the American Surgical Association, May 31, 1923.

Fascial transplants have been used with occasional success in the animal experimentations, but all too frequently result in failure when the same are utilized in the pathological common duct. The earliest recorded case of an attempt to reconstruct over a tube a common duct I could find was that of Jenckel, November, 1905, who endeavored to reconstruct a duct by suturing one end of a rubber tube in the common duct, then inserting the other end in the duodenum after the Witzel method for *temporary* gastric or jejunal fistula, that is, by burying the tube by suture in a fold of the duodenal wall for one or



FIG. 1.—Schematic drawing showing catheter placed in common duct through both proximal and distal ends into the duodenum.

two inches before perforating that wall. The chief value and point in Witzel's procedure was to produce a temporary channel that would close with the removal of the tube. The very thing to be avoided then in establishing a new common duct! In fact, in the case mentioned, Jenckel, three weeks after operation, inserted his finger into the fistulous tract to remove the tube. Traction on it tore open the duodenum along the Witzel suture, with a resulting desperate duodenal fistula, and extremely tedious convalescence. Strangely enough, after months, the wound epithelialized sufficiently internally before it closed externally to establish a nexus between proximal stump of duct and

duodenum! After more than a year's time, the patient was discharged cured.

In October, 1907, I relieved temporarily a chronic intermittent jaundice with fistula, by excision of the fistula, removal of a somewhat dilated remnant of a cystic duct with stones, and removal of stones and grit from the common duct at the junction of cystic with common. A probe passed down freely into duodenum, and when palpated revealed the distal portion of duct surrounded by much indurated and cicatricial tissues. Duct was dilated above site of stones, but being patulous to fluids and to probe, no effort was made to dilate the narrowed portion. A small soft rubber catheter was passed down the duct well into the duodenum and the wound closed about the catheter. Recovery uneventful: healing in seven weeks.

Nine months later, after several recurrent attacks, chills, fever, and jaundice, patient was reopened. Stricture found about site of former opening, the duct this time being opened nearer duodenum. Probe passed easily downwards through ampulla: efforts to pass same upwards met with failure, except

with fine Bowman's probe. Splitting of stricture and excision of scar-tissue revealed duct dilated above to easily admit No. 16 English sound. Insertion upward in proximal dilated duct of a rubber tube was made, the end of which had a double revers cuff enlargement, and fastened in place by a twenty-day chromic encircling suture. The free end of the tube was carried well into the duodenum through the distal duct and ampulla, so that six to eight inches protruded into the duodenum; the ends of duct were approximated with fine catgut sutures. Wound closed with cigarette drain down to line of duct suture. No bile leakage through wound.

At this point, let me express the agreeable surprise that has been mine in most of these cases, namely, that the majority of them have leaked no bile at all, though there had been no thought of a hermetic suture, as evidenced by the fact that drainage was always provided for. With the flow so freely possible through the catheter into the duodenum, it would appear that there existed an almost negative pressure in the common duct. This has been equally true when unable to find or utilize the distal portion of the duct, the catheter has been inserted through a simple opening in the wall of the duodenum and held there with a double purse-string suture of silk, tied tightly enough to be temporarily hermetic, sutures to be finally cast off with the catheter. Every justifiable effort, however, should be made to find the distal end of common duct before resorting to the direct union of the proximal end of the duodenum, because of the potential danger of an ascending cholangitis. One of this series, while absolutely free of jaundice, has from time to time chills, fever, malaise, lassitude, and all the signs of a cholangitis without bile in urine, skin, or sclera, and with normal stools.

Returned home in five weeks. All symptoms disappeared. Tube passed per rectum thirty-three days after insertion. Seven other cases have since been so treated with satisfaction.

Two years later, the excellent experimental work of Sullivan demonstrated the possibility of successful reconstruction of the resected common ducts in animals, by the insertion and maintenance there within the lumen of the ducts of rubber tubes during the time necessary for epithelization. These experiments resulted in the evolution of the T or fishtail tube, and Sullivan had



FIG. 2. Shows X-ray picture of tube in the common duct. This was one of the earlier cases operated and took nine weeks to be discharged via the intestines.

successful cases to report in the human in 1912. At a clinic given for the American Society of Clinical Surgery at Heidelberg, Germany, by Professor Wilms in the summer of 1912, we were shown as a recent discovery by him how to utilize a rubber tube for the purpose of repairing common duct defects!

Following Sullivan's early recommendations, came many successful applications in practice, usually with some means for the removal of the tube when it had completed its work. The well known T tube, having demonstrated the

possibility of repair, has (like the Murphy button) given place to other methods, and for these reasons:

1. That in the effort to remove it, the short end of the T has several times been torn off instead of pulling through the opening of the common duct, or,
2. Has so torn the duct as to reproduce the original stricture.

Tying a strong ligature to the tube within the duct, by which it may later be forcibly removed through the wound is open to same objection. Leaving a short tube permanently in place in the duct itself is to be condemned because of the ultimate deposit



FIG. 3.--Shows tube in common duct and duodenum taken with barium meal in stomach and shows relationship of tube to pylorus and duodenum. This tube also shorter than those now recommended.

of bile with recurrence of symptoms, as in Case II of this series. In this case, I thought I had passed the tube through into the duodenum far enough to insure its escape by the alimentary tract, but operation one and one-half years later revealed bile deposit on the tube and in duct.

If there be one thing more than another that I desire to emphasize in this contribution to duct repair, it is this: that by the constant duodenal and jejunal "tug" upon a catheter inserted through the duct or side of the duodenum it will ultimately be drawn into the intestine and discharged per rectum. In the eight cases I have had, the shortest time of discharge has been twenty-seven days; the longest sixty-three. Hence we have a method of getting rid of a tube without a secondary interference. When, however, it has been deemed necessary to have it remain until the surgeon desires its removal, this has been readily accomplished by tying to the catheter a simple waxed silk ligature, which, brought out through the interval between the ends of the duct being repaired, is carried through a very small rubber tube reaching from the duct to the

surface of the body and fastened to an adhesive strip, the small tube covering the thread for its protective effect against cutting of tissues by the thread. When ready to cast off, the anchorage thread is cut at the surface of the skin. Within three to seven weeks, the catheter passes off through the alimentary tract, and the cure is completed.

This brings us to the question of how much of a gap between the distal and proximal ends can be thus repaired? Since by means of the anchoring thread we have a means of controlling the escape of the tube, it is simply a matter of judgment as to how long it will take the epithelium to grow between the two ends. No experiments of this nature are available; but in Case IV, where one-half to three-quarters of an inch had been excised, the thread was cut in four and one-half months, the catheter passing in five weeks, and the patient now well two years.

CASE REPORTS

CASE I.—G. L., a man of forty-eight (?), who, while seeking operation for a simple right inguinal hernia at a neighboring clinic, awoke to find that an appendectomy and the removal of a stone from the gall-bladder added to his herniotomy had been done. With a biliary fistula persisting for a year, he returned to the



FIG. 1.—Small catheter passed down through common duct and out ear. The surface of the case is fixed to the body by surface sutures. Epithelization of lining surface of duct had had time to occur. Thread cut at the end of four and one-half months, tube passed in five weeks. Patient well two years.

Clinic, when a cholecystectomy was done, with prompt recurrence of the biliary fistula. After another year's interval of alternate opening and closure, followed by jaundice and fever, he returned for the third time to the Clinic for search for the source of common duct obstruction. During this fourth interference, so severe a hemorrhage occurred as to make it necessary to desist, leaving the hæmstatic forceps *in situ* and packing the wound, returning the patient to bed to recover from loss of blood, shock, and so forth. The patient recovered and the wound healed (with the fistula persisting) and he returned home. While the fistula was draining, the patient was comfortable; when closed for three or four days, there was recurrence of jaundice, chills, fever, and common duct symptoms. After a lapse of several months, the patient was brought to the writer.

October 1, 1907. On this date and with the above history, an exploratory operation was made, following with great difficulty the course of the fistulous tract through a mass of adhesions of the stomach, liver, colon, and duodenum, to its source in a small remnant of the cystic duct, big enough to admit the index finger-

tip, and containing muco-purulent bile with black biliary grit. Splitting open this pouch and its communication with the common duct, the latter was found dilated above this point sufficiently to permit palpation of right and left hepatic branches; below this point, an average sized probe could be passed down into the duodenum. Two stones could be felt and they were removed from the dilated common duct, mixed with mucopus and grit. With the probe down the common duct, palpation revealed the duct, surrounded by much indurated cicatricial tissue, but, as the duct was patulous to probe and fluids, no effort was made to remove the narrowed portion or to divide the same. A No. 6 soft rubber catheter was passed down into the

duodenum, and the wound was closed after excision of the remnants of the cystic duct.

Recovery was uneventful. The catheter was utilized while *in situ* to flush out the circulatory system and kidneys by introduction of two to three litres of sterile water daily into the duodenum, this clearing up the jaundice rapidly.

The patient returned home in seven weeks with the wound closed. On March 19th he writes as follows: "December, 1907, first week, wound reopened for several days. December 21st chills, fever, general aching, wound reopened. December 23rd, wound closed and has not reopened to March 19, 1908. No soreness or tenderness at site of incision; stools of good color up to time of attacks, then still yellow, but lighter; no colic at any time; no pains in shoulder or side; there is some jaundice and itching."

FIG. 5. Shows catheter in duct and duodenum held in place by anchor suture to surface of the body eight weeks, at which time thread was cut.

Between April and August, 1908, occasional repetitions of these obstructive symptoms, with septic reactions, led to the reopening of the wound on August 29, 1908, and the finding of a stricture below the formerly opened area, the common duct being this time opened nearer the duodenal junction. The probe passes easily into the duodenum. When trying to probe upwards, stricture found that admits only the smallest size probe. Divulsion of stricture and excision of scar-tissue sufficient to admit No. 16 English sound. On splitting open the stricture, several small black biliary calculi are discharged with free flow of bile. Insertion upward into dilated duct of rubber tube with double revers cuff; fastening same there with chromic gut, then passage of other end well down the duct into the duodenum so that six to seven inches are free in duodenal lumen. Wound closed with cigarette drain to junction of duct ends.

Healing uneventful; no bile escapes through wound; patient returns home in five weeks; all symptoms disappear.

November 1, 1908. Patient writes: "Tube passed this morning; sixty-three days since its insertion. Am better than I have been for three years."

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November 21, 1909. Reports self better than for four years, after extended trip through West. Has none of the old symptoms.

The patient died some years later from a stomach carcinoma.

CASE II.—Mrs. B., entered St. Luke's Hospital, November 1, 1918, for obstruction of the common duct, with jaundice. Reopened the abdomen through old incision for cholecystectomy. No stones palpable in common duct. Pus, blood, albumen, casts (hyaline and granular) in urine. Quick insertion of two tubes at point of probable ligation of former cystic duct where stricture was found and split. One tube was inserted toward the liver in proximal end, and one downwards toward the duodenum, and the wound hurriedly closed, the aim being to relieve cholemia by the simplest procedure. Recovery was good, but there was some intermittent jaundice; itching was gone at the end of the week. One month later still she was somewhat jaundiced.

Second operation, December 23, 1918. Fistulous tract injected with methylene blue, and tract followed through adhesions to the common duct. Opening in it was enlarged sufficiently to insert a $\frac{3}{8}$ inch rubber tube into the duct. On the upper end, a cuff or revers had been turned back in order to enlarge its calibre and retard its escape into the duodenum. The tube was about four inches long. The common duct was sutured over the tube at the slit in the stricture. The wound closed with drainage. Wound closed on the eleventh day. Stools became dark and urine light. Discharged nineteenth day (January 11, 1919).

CASE III.—Mrs. S., May 28, 1918. Typical history of biliary colics, nausea, vomiting, and jaundice. Gall-bladder was drained seven years before, after removal of stones by Dr. G. Reoperation revealed an hour-glass stricture of the gall-bladder. Compartment at fundus filled with stones below stricture (probable former purse-string site). The gall-bladder was thickened and infiltrated. The cystic duct was ligated with artery and vein, and cholecystectomy made. The drain was inserted down to the stump. There was free flow of bile on second day. The wound healed, and the patient was discharged July 23, 1918.

December 1st. The patient was sent to the hospital with a chill and fever; leucocytes 15,400, pulse 100; temperature 102.4, urine highly colored; stools light colored. The temperature was normal on the fourth day and the patient was discharged on December 7, 1918.

February 11, 1919. The patient returns to the hospital with jaundice, nausea, and vomiting; pruritus.

Operation.—The abdomen was opened through the old scar. The common duct was identified and opened. The probe passed downward easily into duodenum



FIG. 6.—Lateral view of Case VI, showing unusual course of duodenum.

without obstruction; passed upward to meet the obstruction near the hilus of the liver. The duct was split upwards along the probe to the obstruction, due to connective tissue constriction and scar-tissue. A portion of a small No. 7 soft rubber catheter was inserted with funnel, and was inserted above the constriction, and the other end was passed down into duodenum and then closed over catheter, and a Bullitt drain inserted to the field of the suture. Drain was removed on the



FIG. 7.—Illustrates a new aid to diagnosis of nature of obstruction in common duct. If the patient be studied fluoroscopically by lateral view during the passage of barium through the duodenum, it is many times possible for the roentgenologist, by massaging the duodenum, to make the barium enter the lower end of the common duct; if stone be present, to so coat the stone with barium that it will then show for many days in an X-ray picture. A stone endeavoring to escape from the common duct is probably preceded by a relaxation of the distal end of the duct, similar to the softening and relaxation that occurs in the uterine cervix with the descending head of child. I would ask the members in their future cases of suspected common duct stone obstruction, to test out this observation, as I believe they will have frequent gratifying confirmation of their suspicions. Emphasis must be laid upon the need of lateral observation of the patient, because the common duct enters into the duodenum posteriorly and such a condition could not be seen through the full duodenum.

discharged on December 30th. Tube passed the 27th day.

CASE IV.—Mrs. M., December 30, 1912, aged twenty-nine, married. The patient was operated on ten months ago for gall-bladder disease; then again six weeks later. For four months there were intermittent jaundice, pain, and vomiting, and the stools were clay-colored. Stricture of the common duct was found and opened. A tube was inserted with the cuff turned back for the proximal end; the other end was carried down into the duodenum; the duct was sutured over it; the wound was closed with drainage. Recovery was prompt, with relief of symptoms. The tube passed in nine weeks.

CASE V.—Patient aged thirty, married, two children. There was frank gall-stone disease, associated with occasional jaundice. No previous operations.

seventh day, February 18th, stools normal on the second day. The patient returned home, healed, on March 3, 1919.

After one and three-quarter years of comparative comfort, the patient again showed jaundice. On December 14, 1920, the abdomen required re-opening. The common duct was reached through the adhesions without seeing free peritoneum. Opening the same, revealed a black silk suture as the nucleus of a gall-stone at site of former stricture. It was deemed advisable to suture the proximal end of the common duct to the new opening inside of the duodenum. This was done by inserting a purse-string suture in the duodenal wall, passing nearly the whole catheter down the duodenum through the small buttonhole incision and tightening the purse-string suture. The funnel end was inserted in the proximal end of the common duct above the stricture, and the common duct end was sutured to the duodenum by four fine silk sutures. A drain was inserted to the bottom of the wound and removed on the seventh day. The patient was

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Operation on June 9, 1921 at St. Luke's Hospital. The simplest type of cholecystectomy was done, following the best known technic of subperitoneal resection of the cystic duct after satisfactory isolation and identification of both artery and duct. I never did a more comfortable, easy cholecystectomy. There were many stones. After the wound was closed and the patient was in bed, inspection of the specimen showed a peculiar $\frac{3}{4}$ inch tubular structure attached to one side of the cystic duct portion of the gall-bladder. Immediate frozen section showed it to be lined with epithelium similar to the duct. I immediately realized my mistake, told the family physician, (who had watched and complimented the careful operation) and the relatives frankly what had happened and explained the necessity of immediate opening of the wound to resuture the duct. This was done. The ends of the duct were picked up and the catheter was passed down almost entirely into the duodenum through the distal portion. Inasmuch as there had never been any dilatation of the common duct, it was not feasible to insert upwards the funnel end of the catheter, so the funnel was amputated, and the cut end passed up to the liver. In order to anchor it in place, a medium sized wax silk ligature was tied to the catheter at the area uncovered by the duct and anchored to the surface of the skin by adhesive plaster; then the ends of the ducts were approximated toward one another to within half an inch. The wound was sutured. Some bile discharged until the anchor thread was cut four and one-half months after operation, September 14th. The catheter passed November 7, 1921. The wound ceased leaking in ten days after the thread was cut. The patient was then apparently perfectly well. See X-ray chart of catheter *in situ*.

CASE VI.—O. E. C., age sixty-seven, white, married, male. Onset two weeks ago, weakness, anorexia, heaviness in stomach, nausea, emesis. Jaundice began two days later and grown steadily deeper, with clay-colored stools. Past history negative. Entered hospital, February 17, 1923. Temperature ranging up to 101.6; pulse 100; respiration 24. Blood count: reds 4,450,000; white 18,400; haemoglobin 95 per cent. Urine, loaded with bile, otherwise negative. Stools acholic. Physical examination, general abdominal rigidity.

Operated February, 19, 1923. Massive adhesion about gall-bladder, which was found to be very small, thickened, filled with small stones and muco-purulent material, and no bile. Lining ulcerated. Gall-bladder removed. Cystic end ligated. Common duct greatly distended to such a size, it was at first mistaken for duodenum. A large stone found wedged in ampulla of Vater—removed through slit in common duct. A small No. 14 Fr catheter was fed downward through this slit into duodenum, all but last two inches which was fed upward with its bell-mouth towards the liver in the common duct. A heavy silk anchor line tied to catheter at point opposite slit in common duct, was carried out and fixed to skin by adhesive. Slit completely sutured around anchor line. Abdomen closed with accessory Bullitt drain for two days.

Patient made uneventful recovery; jaundice rapidly disappeared; never any discharge of bile dressings. X-ray picture of March 15, 1923 (slide No. 6) shows catheter still in place. Anchor line cut March 15th. Patient last heard from June 1st feels entirely well and is attending to business; is not sure whether he has passed catheter or not. Advised to have X-ray picture taken to prove this.

CASE VII.—J. L., age fifty, male, white, married. Present complaint, intermittent jaundice, alternating with intermittent biliary fistula, following an operation done elsewhere one year ago for relief of typical gall-stone history of three years duration. History otherwise negative. Entered St. Luke's Hospital, February 5, 1923. Examination shows small discharging biliary fistula in an otherwise healed right rectus scar. Blood and urine normal. Stool negative. A diagnosis was made of common duct stone from history and especially from an X-ray picture

taken during the course of a barium gastrointestinal examination, which left stone plainly coated with the barium (see Slide No. 7), which had regurgitated into ampulla and remained behind when the duodenum had emptied itself.

Operated February 7, 1923. Fistula traced down through adhesions to remains of a badly diseased gall-bladder, which was removed. A large stone easily palpable in the ampulla of Vater could not be milked back into the common duct. A transduodenal choledochotomy allowed removal of stone. Then a fine catheter was fed through stump of cystic duct, through the common duct into the duodenum: the other end of catheter brought out to the skin. Fenestra had first been cut in side of catheter in that portion contained in common duct. The hole in the duodenum was then completely closed with a double row of silk stitches. Abdomen closed with accessory Bullitt drain. Patient made uneventful convalescence. Catheter removed at the end of a week. Patient last seen June 4th; feels fine; has gained twenty-five pounds; back at work.

A QUESTION OF SIZE*

BY WILLIAM J. MAYO, M.D.

OF ROCHESTER, MINN.

WHEN Brown, the English botanist, began the observations on physics which culminated in his written communications of 1827, he focused attention on a subject of enormous importance. The questions he raised a century ago are to-day perhaps the most important of all those before the scientific world. Brown noted, as man undoubtedly had noted from time immemorial, that when a pencil of bright light was thrown into a dark room, there were to be seen in the air certain rapidly moving particles of which there was no other physical evidence. On experimentation he found these dancing motes under conditions in which freedom from air disturbance of any kind had been obtained, and he further noted with the microscope the continual movement among minute particles suspended in a liquid. Because of his investigations the peculiar vibratory motions of these particles were called Brownian movements. The great physicist, Dalton, was at this period working on the atomic theory and the constitution of the molecule, and in connection with his investigations the so-called Brownian movements were even more happily designated "the dance of the molecules." The most important contribution to a proper understanding of these phenomena was that of Thomas Graham, Master of the Mint in London, who in 1861 published his painstaking observations which led to the first great description of colloid bodies. Graham's work was largely based on dialyses of colloid-sized substances through parchment paper. Tyndall called attention to the curious phenomenon occurring in the track of a luminous beam (called the Tyndall phenomenon), the colorings of which are the effect of sunlight on colloids in the air, and investigated the transparency and opacity of gases and vapors under radiant heat.

To those who have given little thought to the term *colloid*, especially as it is used in medicine, the word appears to have some special meaning over and beyond that of size, but as a matter of fact, colloid refers only to size. Dividing matter into three great groups, there are first, those objects which can be seen directly with the eye, or with the eye aided by the microscope. The best microscope has a magnification which will reveal objects of $1/10$ micron in diameter. Second, at the other extreme, there are the atom, the molecule, and the electron, which cannot be seen. Third, those particles of matter lying between the two extremes in size ($1/10$ of a micron or $1/250,000$ of an inch, and $1/1000$ of a micron or $1/25,000,000$ of an inch) are called colloids. In this third or colloid group, the particles are too small to be seen directly, but the colloid-sized particles are large enough to scatter a ray of light and they therefore refract the light ray. The atom, the molecule, and the electron are too small to scatter the light ray and therefore do not

* Read before the American Surgical Association, June, 1923.

refract it, although under experimental X-ray conditions the nucleus of the atom was demonstrated by Thompson and Aslton. Definite relationships can be shown, as evidenced in 1913, by the remarkable work of Henry Moseley, a young Englishman, whose death in the Gallipoli campaign was one of the irreparable losses of the Great War. Moseley analyzed the atom by the reflection of X-rays and showed that there were ninety-two possible elements between hydrogen, the lightest, and uranium, the heaviest, all but four of which are now known.

The ultramicroscope which is used to catch the reflection of the colloid bodies gives no idea of the shape or the composition of the object itself, but by serving as a mirror and reflecting the light shows that such a body is actually present. The shortest ray of electro-magnetic vibration is the gamma ray from radium, $1/1,000,000,000$ of an inch. The next is the X-ray, which is about $1/100,000,000$ of an inch. It was with this extremely short X-ray that Moseley did his work. The wave length of the X-ray, which in this connection amounts to the same thing as size, is $1/50,000$ as great as the yellow light ray from the sun, and it is to this property that the X-ray owes its great penetrating power. The shortest light ray visible to the eye is approximately $1/30,000$ of an inch in length. The longest waves, hertzian, are the so-called wireless, which are from one-half mile to four or five miles in length, and experimentally have reached the length of 1200 miles or more.

A most remarkable fact is that colloids, atoms, molecules, and electrons are not greatly affected by gravity and remain in rapid motion more or less permanently suspended in their medium, although all are affected by pressure, temperature and atmospheric conditions. The evaporation of water is an illustration of this property. Water exists in the atmosphere, but under certain conditions does not greatly feel the pull of gravity. Under specific atmospheric conditions, however, as when the evaporated water rises to a height where the air is rarefied and by greater coldness than exists at the point of evaporation, it gathers together in colloid form as clouds. For rainfall of an inch and a half to an acre, 144 tons of colloid water practically unresponsive to the pull of gravity are suspended over each acre; if the change from a dispersed to a fluid state takes place rapidly, the electrical energy on the surface of the colloidal particles is given off as an electrical disturbance, thunder and lightning.

Gortner and his pupils may influence the feeding of the world by their discoveries of the importance to plants, of water in a bound form, and their demonstration that the effect of freezing and dryness on plant life depends on whether the water contained by the plant existed in a free form or a bound form. The difficulties which stood in the way of finding food plants which would withstand winter killing were enormous. Years of patient waiting were often necessary before weather conditions existed to make the demonstrations possible. When Gortner conceived the idea that water might exist in a bound state uninfluenced by ordinary conditions, atmospheric or thermic, he found that if plants which did not winter kill were pressed in a hydraulic

press, little or no juice was obtained, and that the amount of juice that could be expressed was directly related to the ability of the plant to withstand frost. He found that those plants which would not winter kill contained little unbound water, that is, water in a free form, while those that were destroyed by freezing contained relatively a large amount of free water. Carrying his experiments out in the desert, he found conditions comparable to drought; plants that could withstand dryness contained water, as did other plants, but in a bound form. Experiments in the compression of water, which is one of the most incompressible of all substances, have shown that the water in a film on colloid surfaces can be compressed to 75 per cent. of its volume, and that under such conditions it behaves as a solid and does not evaporate at 300°C . in a complete vacuum.

We know that a substance in solution, common salt, for instance, exists, although it can no longer be seen; when the water is evaporated the salt is again in evidence. If a pencil of light is thrown through such a solution it will not be diffused, showing that the light rays have not met bodies in the solution which are larger than the ray of light, and consequently the light is not reflected. It was Arrhenius, the Swedish scientist, who defined the electrolytic theory of solution, asserting that salts separate in water into positive and negative parts, and that such solutions are ionic. An ion is an unsatisfied electric charge. A chemical reaction is always accompanied by an exchange of electric charges between elements; the ion carries a definite charge and moves with the electric current. Colloids, atoms, and molecules may give off electrical energy under certain conditions.

One may well ask, Where does the energy contained in the atom, molecule, and colloid reside? The Nobel Prize in Physics for 1922 was given Dr. Niels Bohr of Copenhagen, who about ten years ago revealed his conception of the atomic system as a solar system in which the sun is represented by a nucleus of positive electricity and the planets by rapidly revolving negative electrons, and on this theory he calculated the wave lengths of light in each line of the spectrum. The positive core of the atom is exceedingly dense and heavy compared with the electron, in which the activity of negative electricity resides. The positive core might be said to be the electric centre of gravity toward which the negative electrons constantly are pulled. Knowledge of electrical energy is largely based on an understanding of the negative electron which is only 1/1800 the density or weight of the positive hydrogen nucleus which is the smallest and lightest of known atoms of matter. It is because of its extremely small size and weight that the negative electron can move with such extraordinary rapidity through solid substances, especially copper and other electrical conductors.

The force that exists in the atom and molecule is inconceivable. Rutherford, the great physicist, says that he looks forward to the day in which energy for all our uses will be atomic. One of the scientists associated with the General Electric Company says that there is sufficient energy in a teaspoonful of water to drive the largest battleship across the ocean. The electric

power in the molecule depends on the mass of the nucleus, that is the number of positive charges in the mass, and the number of negative electrons circulating around the positive nucleus, the charges in the more stable compounds going up in arithmetical progression of four, the octet being the most stable.

Most of the biochemical reactions in the body depend on physical states. Krogh, whose experimental studies of the blood capillaries won for him the Nobel prize in physiology in 1920, has added greatly to our knowledge of the mechanism of body nutrition. It had been believed that the capillaries were endothelial channels in the tissues, but Krogh has confirmed the observation that even the finest capillaries contain smooth muscle fibres through the walls of which oxygen and crystalloids, such as glucose, salts, and the amino acids, supply the body cells by diffusion. Diffusion depends on pressure. Crystalloids are in a molecular state and penetrate the capillary walls everywhere, because the pressure inside the arterial capillary is greater than that in the tissue space, and greater in the tissue spaces than in the venous capillary which receives the waste products of oxidation. Unless there is great dilatation of the capillaries, which increases their permeability to larger bodies, the colloids normally do not penetrate the capillary walls, except in the liver and gastro-intestinal tract. Histamin dilates the capillary wall so that its interspaces permit the escape of larger-sized particles such as colloids, and as in shock the experimental animal bleeds to death in its own tissues. The colloids of the blood are of different sizes; hence, there is variation in the permeability of the capillary wall to different colloids. The osmotic pressure, the state of dilatation of capillaries, and the size of the colloid molecule are the controlling factors. Increased work of any organ of the body causes dilatation of the capillaries. This power of dilatation and contraction lies in the non-striated muscle coat of the capillary. Variations in calibre of the capillaries may be brought about by the many influences which affect life processes and are to a great extent independent of nerve control. For instance, the effect of cold on the skin is to produce contraction of the arterial capillaries, resulting in blanching, which is followed by blueness due to dilatation and stasis of the venous capillaries distended with non-oxygenated blood. One can conceive that many substances said to be poisonous are poisonous because of their physical condition; certain tissue filters may become plugged by particles which of themselves are not poisonous in the chemical sense, but are attracted to certain localities and plug the normal interspaces, suspending internal respiration.

The point should be emphasized that normally the blood capillaries pick up only molecular substances or extremely fine subdivisions, soluble in water. Generally speaking, it is the function of the lymphatics as absorbents to pick up material substances insoluble in water, such as bacteria, protozoa, and the cancer cell, which are too large to enter the blood capillaries. This absorption is through the agency of phagocytes which by diapedesis reach the lymphatics. The reactions in the lymph-nodes represent the struggle of the gland to detoxicate these pathologic agents. The lymphatic channels lead from one

gland to another, but in each gland they break up into lymphatic capillaries, varying from a micron to 1 mm. and into endothelium-lined pockets and sinuoids before they are gathered again into the larger lymphatic channels for onward movement. These physical facts are of the greatest importance in relation to the infections which spread by way of the lymphatic system, such as tuberculosis, syphilis and cancer.

Bacteria are electronegative, but the bacterial spore carries a positive charge. Evidence goes to show that endothelial cells which are phagocytes are electropositive. This research is incomplete, however, as an entire series of cells has not been worked out.

An idea of the minuteness of the constituents of a cell is gained from the following estimated analysis. A cell is composed of (1) protein, which is always colloid; (2) carbohydrates, which may be either crystalloid or colloid; (3) lipoids or fats, which are either colloids or emulsions; (4) salts, which are crystalloid, and (5) water, some part of which, large or small, depending on the physiological state of the cell, may be in colloidal form. As a specific instance, the composition of a liver cell, expressed in molecules, is estimated to be: protein, 53,000,000,000; fats and lipoids, 166,000,000,000; salts and other crystalloids, 2,000,000,000,000, and water 225,000,000,000,000.

Perkin, working in the Royal College of London, discovered the dyes which Hofmann took back to Germany and which were the basic discoveries that gave rise to the explosives exploited in the World War. Abel and Rowntree in 1909, and Rowntree and Geraghty in 1910, in working on the elimination of aniline dyes from the kidney, were led to the discovery of phenolsulphonaphthalein as an index to renal function. Evans has shown that dye elimination is purely a question of physics, that is, of the size of the dye particle which is permitted to pass the kidney filter. Bowman, for whom Bowman's capsule was named in 1842, made the first of that long line of studies on the malpighian bodies in relation to the system of tubules of the kidney, work continued later by Ludwig, Cushny, Marshall, Richards, Drinker, and others, which suggested that the essential action of the kidney was that of a filter. Sollman, seventeen years ago, in his perfusion experiments found that the kidney of an animal removed from the body could be made to filter urine. Cushny by his pharmacological investigations of the elimination of drugs from the kidney developed most important data as to kidney filtration. While it is true that urea is excreted in small amounts in the saliva, through the skin, the mucous membranes of the intestine, and so forth, the natural urea filter is the kidney. In this connection it is most interesting to note that urea is one of the smallest of the molecules, being but slightly above atomic size, and that it is non-hydrophilic, that is, it does not absorb water. For this reason it is one of the most diffusible molecules and passes with great rapidity in and out of the tissues of the body. While urea is non-hydrophilic, its elimination through the kidney is closely associated with the water balance. Reduced area output is accompanied by a corresponding

increase of the watery constituents of the urine if a fair degree of renal function is maintained.

Sir William Crookes, who died in 1919, was the last of the great all-around physicists. Physics has grown so tremendously that each physicist of to-day can claim to have accurate knowledge of only a small part of the subject. Crookes, in his attempts to demonstrate the fourth state of matter, exhausted the air from a heavy glass bulb. When certain electric attachments were made, the bulb became filled with luminous matter, and, as Crookes expressed it, "actually touched the border land where matter and force seem to merge into one another." He named this luminous substance the cathode ray, which was later shown to be composed of negative electrons, which is the fundamental conception of the X-ray. He pointed out also that when X-rays come in contact with solid matter they give rise to shadows, and that the cathode rays, when outside a magnetic field, always travel in a straight line. Röntgen was working with the Crookes' tubes when he discovered the X-rays. The use of energy in the form of rays such as radium, X-ray, and so forth, are examples of biophysics in relation to medicine. Bayliss, speaking of chemistry and physics, says that "The boundaries between these two branches of science are rapidly becoming obliterated."

When we survey the modern field of research which goes under the general title of biophysics, the commercial inventions and developments that concern physics in the sciences and arts, we get some idea of the importance of this work which has been neglected in its relation to medicine. Problems worked out in connection with industry, agriculture and animal husbandry have raised scarcely a ripple in medicine. Perhaps we have been subject unconsciously to the theologic opinions which have recently been so broadly emphasized by a world-known orator who believes that man was created independently, and not through evolution of preëxisting species, a view more flattering to our vanity than to our intelligence. One cannot help, however, but sympathize with his recent vehement defense of the ape, as not responsible for man.

Perhaps enough has been said to further the plea that biophysics be given a more important place in the medical school curriculum, and that some of the time of the overburdened students of medicine now occupied by chemistry be given to medical biophysics.

SURGERY OF THE THYROID AND ITS MORTALITY*

BY CHARLES H. MAYO, M.D.

AND

JOHN DE J. PEMBERTON, M.D.

OF ROCHESTER, MINN.

FROM THE MAYO CLINIC

DURING the last sixteen months, to May 1, 1923, 2524 operations were performed on 1949 patients with goiter. Twenty-five died, a mortality by operation of 0.99 per cent., and by case of 1.28 per cent. Unless accurately classified according to the presence or absence of hyperthyroidism, these percentages have no special significance, for an adequate appreciation of the mortality from surgery of the thyroid gland is dependent on the understanding of the operative dangers incident to the various types of goiter.

According to the dangers attending surgery, all lesions of the thyroid may be classified into two groups: goiters unassociated with hyperthyroidism, and goiters associated with hyperthyroidism. The operative risks in the two groups are not comparable. In the former, the dangers are confined to the accidental causes to which any operation of equal magnitude is subject, while in the latter the greatest danger lies in the disease itself, or the residual effects of the disease. For instance, the technically successful operation may precipitate or be followed by an acute exacerbation of hyperthyroidism, from which the patient does not recover. It is obvious, then, that the mortality rate in "goiter surgery" is decidedly influenced by the proportion of goiters without hyperthyroidism included in the computation.

The goiters unassociated with hyperthyroidism, and which are amenable to operation, include adenomatous goiters, malignant goiters, thyroiditis, and occasionally the colloid goiter. As the health of the patient is unaffected by the goiter, the dangers involved in its removal are limited to operative and post-operative accidents, which include hemorrhage, pulmonary infections, obstructive dyspnea, tetany, air embolism, pulmonary embolism, infections, and intercurrent diseases.

With the development of the standardized operation, and care in the details of operation, technical errors have been reduced to a minimum. In the Clinic, the incidence of post-operative obstructive dyspnea and pneumonia have been materially decreased since it has been appreciated that both are at least

* Read before the American Surgical Association, June, 1923.

partially avoidable. In the past the causes of post-operative obstructive dyspnoea were believed to be confined to collapse of the trachea and oedema of the glottis, both unavoidable complications, but in recent years a clearer recognition of the important part played by the injury of the recurrent laryngeal nerve, has led the surgeon to exercise more care in its avoidance; in consequence, post-operative obstructive dyspnoea has been practically eliminated as a danger in goiter operations. Likewise the incidence of post-operative pulmonary infections has been materially reduced by the avoidance of prolonged anaesthesia, and of injury to the recurrent laryngeal nerve.

Intercurrent diseases, such as diabetes, influenza and thrombosis, are unavoidable complications, but must be considered if, as is the practice in the Clinic, the mortality rate is to be computed from all patients who die in the hospital without regard to the cause of death or the length of time after operation.

In the last sixteen months 819 thyroidectomies were performed on 819 patients. Three patients died, a mortality of 0.36 per cent.

The goiters associated with hyperthyroidism include exophthalmic goiter and adenomatous goiter with hyperthyroidism. The development of acute hyperthyroidism, and the presence of visceral degenerative changes, comprise the added dangers to surgery in both types, but as the relative importance of these dangers varies in the two types, and as pre-operative measures are not comparable in efficiency, it is desirable to discuss the surgical problems of the two diseases separately.

Exophthalmic Goiter.—Visceral degeneration in patients with exophthalmic goiter, due to the long continued hyperthyroidism, was formerly the most important cause of the high operative mortality. But in recent years, owing to the wider dissemination of the benefits derived from surgery, a larger proportion of patients with exophthalmic goiter are coming to surgery earlier in the course of the disease, and before the development of visceral changes. This is illustrated in a forceful manner by a comparison of the data for different periods, relative to the duration of hyperthyroidism. In 1900, the average duration of hyperthyroidism in the series of patients with exophthalmic goiter was thirty-one months; in 1916, twenty-three months, and for the first six months of 1922, nineteen months. This fact has influenced not only the reduction of the operative mortality, but the improvement in the end results.

Our means of combating the post-operative reaction of hyperthyroidism or dysthyroidism when once induced, are ineffectual. The mode of attack lies rather in prevention. Through the coöperative efforts of the internist, the laboratory workers, and the surgeon, great improvement in the pre-operative preparation of these patients has been accomplished, so that to-day the occurrence of post-operative reactions has been reduced to a minimum.

The pre-operative preparation consists of medical and surgical measures. About 30 per cent. of the patients, on admission to the Clinic, have only a mild degree of hyperthyroidism, and as their general health is unimpaired, preliminary treatment other than routine preparation is unnecessary. Preliminary treatment is indicated in the other 70 per cent. of patients on account of the intensity of the hyperthyroidism, or the patient's debilitated condition. At first, until sufficient data was acquired, preliminary treatment was carried out in the hospital in all instances, but gradually it has become possible to make selections, so that now patients with mild hyperthyroidism are prepared outside the hospital. The medical measures employed for patients with severe forms of the disease consist of rest, adequate food and fluid intake, digitalis as indicated, and the oral administration of iodine (Lugol's solution). By repeated basal metabolic estimations at intervals of three to four days, the progress of the disease can be accurately watched. Improvement in the condition of the patients is usually apparent in from ten to fourteen days, and a large number of these become safe risks for primary thyroidectomy. If doubt still exists as to operative risk, a preliminary surgical procedure, such as injection of hot water, or a ligation, is indicated as a tolerance test. A further number of the patients, who show no reaction to these procedures, are judged good risks, and the operation is then completed. Because of extreme loss of weight or strength, or because of the presence of marked visceral degenerative changes, in a small percentage (20 to 25 per cent.) of the total number of patients with exophthalmic goiter, two ligations and a three months' period of rest are indicated.

The lowered operative mortality alone has fully justified the employment of the combined medical and surgical management of patients with exophthalmic goiter. Thus, during the last sixteen months ending May 1, there were 1398 operations on 853 patients with exophthalmic goiter. Thirteen died, a mortality by operation of 0.92 per cent., and by case of 1.5 per cent.

A comparison of the operative procedures employed in the first four months of 1923, with those of the same period for the five preceding years, is interesting. Primary thyroidectomy was performed in 56 per cent. of the patients in 1923, while the average for the five preceding years was only 38 per cent. Twenty-four per cent. of patients had two or more ligations before thyroidectomy in 1923, and the average for the five preceding years was 37 per cent. Expressed differently, under the combined medical and surgical management, primary thyroidectomy has increased 18 per cent., and the necessity for two or more ligations has been reduced 12 per cent.

Adenomatous Goiter with Hyperthyroidism.—The added dangers of surgery in this type of case are also due to the possibility of the development of acute hyperthyroidism, and to the presence of visceral degenerative changes. Owing to the usual mild intensity of hyperthyroidism, the possibility of an exacerbation of severe acute hyperthyroidism is of relatively

small significance, while the presence of visceral degenerative changes is the most influential factor in the mortality rate. In this respect adenomatous goiter with hyperthyroidism differs from exophthalmic goiter. In cases of exophthalmic goiter, the symptoms may begin gradually or abruptly, prior to, coincident with, or shortly after the appearance of the goiter; thus the patient realizes early that he is not well, and seeks relief soon after the onset. But in cases of adenomatous goiter with hyperthyroidism, the patient has had a goiter without symptoms for many years, and the onset of hyperthyroidism is so insidious that the disease often progresses to a stage of visceral degeneration before he realizes any change in his condition, and operation is accordingly delayed. Because of this and because of the fact that preparatory measures are inadequate, the operative risk is relatively high.

During the past sixteen months there were 277 patients with adenomatous goiter with hyperthyroidism operated on. Nine patients died, a mortality of 3.24 per cent. It is obvious, therefore, that the mortality rate is dependent more on the number of bad risk patients accepted for operation, than on any factor in the operative or pre-operative management. Because of the facts that the successful removal of the adenomatous tissue is followed in from ten to fourteen days by the complete subsidence of hyperthyroidism, and that the improvement is immediate in many of the otherwise hopeless cases, extension of the limits of operability to include nearly all patients is justified.

CONCLUSIONS

1. In order to evaluate accurately statistics on the results of operations on patients with goiter, the knowledge of two facts is essential, the proportion of goiters without hyperthyroidism included in the computation, and the basis on which operative mortality is reckoned.

2. The operative risk in cases of goiter without hyperthyroidism cannot be compared with that of goiter with hyperthyroidism; in the former the dangers are confined to the operative and post-operative accidents; in the latter the greatest danger lies in the disease itself.

3. The reduction of the mortality to 1 per cent. in surgery of exophthalmic goiter is attributable to three factors: (a) patients with exophthalmic goiter are coming to operation earlier in the course of the disease, before the development of visceral degenerative changes, (b) by the combined medical and surgical management, the development of post-operative acute hyperthyroidism has been reduced to a minimum, and (c) a clearer recognition of the dangers involved in the injury of the recurrent laryngeal nerve has led the surgeon to greater care in its avoidance.

4. The combined medical and surgical management of patients with exophthalmic goiter is warranted from the economic standpoint, as it has reduced the necessity for ligations.

SURGERY OF THE THYROID AND ITS MORTALITY

5. As preliminary measures are ineffectual in adenomatous goiter with hyperthyroidism, the mortality rate is dependent on the number of bad risk patients accepted for operation.

Report of Cases of Goiter, January 1, 1922 to May 1, 1923

	Cases	Mortality	Per cent.
Thyroidectomies for exophthalmic goiter* ..	703	6	0.85
Ligations preliminary to thyroidectomy for exophthalmic goiter ..	591	5	0.84
Hot water injections preliminary to thyroidectomy for exophthalmic goiter ...	101	1	0.99
Injections 0.5 novocain preliminary to thyroidectomy for exophthalmic goiter ..	3	1	33.33

*The thyroidectomies were complete operations in one stage, except in two instances, in which the technical difficulties made it advisable to divide the operation into two stages.

THE MANY-STAGE OPERATION FOR GOITRE*

By MARTIN B. TINKER, M.D.

OF ITHACA, N. Y.

THE management of toxic goitre is still one of our difficult problems, after over twenty years intensive study by many active workers. There is fairly general agreement that surgery offers the most reliable treatment, after extended trial of serums, endocrines, radium, X-ray, and a host of other measures. There is also quite general agreement as to the value of dividing the operation into stages, but there are still some fatalities from failure to recognize the gravity of conditions calling for the many-stage operation, or the time when even the least intervention can be safely undertaken. Judgment how much to do, and when to do it, still makes the difference between life and death, health or invalidism, in this as in many other fields of surgery.

In a paper entitled "Factors Influencing the Safety of Operation for Goitre" read at the Surgical Section of American Medical Association meeting at Los Angeles, June, 1911, I advocated preliminary study and treatment of from a week to a month, followed by operation in stages, in the management of doubtful cases. Two types of operation were suggested: first, that beginning with elevation of the flap as for excision, and interrupting the operation and packing the wound at any stage when the patient's condition suggested that it may be unsafe to continue much farther. Second, the ligation of one or more important vessels supplying the thyroid gland, as advocated by Kocher, to be followed, as the patient's condition warranted, by further ligation or excision, or possibly by further ligations and repeated partial excisions. These methods still have their place, but further experience has suggested modifications of value, both as concerns safety and permanent results. The most important advantages of these procedures are: (*a*) first of all, greater safety to life; (*b*) the possibility of earlier intervention, thus arresting toxæmia before serious permanent damage results to vital organs; (*c*) extending the range of operability by a relatively trivial and safe procedure, making many desperately ill patients fit risks for later curative surgery. The disadvantages are: slight to considerable extra scarring; added hospitalization and expense; and, as concerns wound packing in many-stage excision, a slight but none the less definite risk of infection. I have never seen infection of any gravity, but where the patient's serious condition seemed to make it safer to delay closure for several days, occasionally there has been low-grade infection, causing delay in healing and some additional scarring.

The chief advantage of ligation is that, by a relatively simple and safe procedure, taking but a few minutes time, approximately one-fourth of the blood supply is cut off, theoretically at least, and the activity of the gland

* Read before the American Surgical Association, June 1, 1923.

reduced to that degree. In actual practice, the reduction in gland activity does not always follow, partly because the collateral branches are so numerous and widely distributed that the blood supply is rapidly reestablished. The number of vessels at the upper pole of the thyroid which we have encountered at the operating table, not usually shown in anatomical reference books, has been so great that my associates and I started several years ago to record them. From a study of two hundred consecutive ligations we found that the text-book descriptions of the superior thyroid artery dividing into main anterior and posterior branches is most unusual; that two or three groups of vessels is common; as many as seven vessels were found in one case; and in another the largest and most active vessel came along the isthmus from the opposite side. One of the earlier editions of Quain is the only text giving any adequate description of the numerous and irregular sources of blood supply to the superior thyroid pole, which we have found the common rather than the abnormal distribution. It is evident that in order effectually to cut off the blood supply of the superior thyroid pole, and get the supposed advantage of ligation, there must be fairly free exposure and the entire blood supply secured. Such increased care to secure all the vessels of the superior thyroid pole has not, in my experience, greatly increased the time required for ligation, and has not added appreciably to the risk of operation. Lobes removed at later partial thyroidectomy, in a considerable proportion of cases, show clearly the effect of complete cutting off of the blood supply, both microscopically and frequently in the gross. In certain cases there is apparent increase of fibrous tissue with lessened gland cells. In other cases the part of the gland, originally hyperplastic, influenced by ligation, takes on the appearance of simple colloid goitre. With widely differing blood supply, there are of course widely differing results following ligation.

Another important advantage of the many-stage operation, with multiple ligations, is the time required. Certain of these patients will die, whatever is done, or if nothing is done; but the majority will recover if sufficient time is taken for rest and preliminary treatment. Goodpasture has shown that there are definite and serious myocardial changes, apparently the result of extreme thyroid toxemia, and it would be unreasonable to expect a heart crippled by myocarditis or dilatation to recover without prolonged rest. The same is doubtless true of damage to the nervous system. The X-ray, which is in great favor in the treatment of such cases in certain localities, has seriously aggravated the symptoms in a number of patients who have come under my observation. These patients have later responded well to prolonged preliminary rest and care, followed by ligations, and later, partial excision. If a year or even more, devoted to preliminary treatment and modified rest cure, between the various operative stages, will bring such a patient back to reasonable health and efficiency, it seems a small price to pay out of the twenty-five to forty years normal expectation of life which many of these patients have. Of course so long a time is unnecessary except in extreme cases. The time element gives such treatment by ligations and later

excisions, decided advantages over many-stage excision in such cases; for even if the patient survives excision, extensive operation in the stage of extreme toxæmia, undoubtedly puts a strain on the heart from which it may never fully recover, after ever-so-prolonged post-operative rest. The considerable number of articles on many-stage excision which have appeared during the past two or three years, lead me to believe that it is being used in some of the cases of extreme toxæmia, in which preliminary ligation, preceded and followed by prolonged and modified rest-cure, and later followed by partial excision, would give better permanent results. Having originally advocated this method and used it in suitable cases ever since, I feel justified in criticising its use in cases in which I feel strongly that the more conservative plan would give better permanent results.

Ligation at the lower instead of the upper pole of the thyroid, I have not used as a part of the many-stage operation, because of (1) risk of injury to the recurrent nerve; (2) greater difficulty, especially with deeply located, especially intrathoracic or substernal growths, or if there were many extra vessels, as has proved so common at the upper pole; (3) the formation of deep adhesions, making difficult a subsequent partial thyroidectomy, not a fanciful difficulty as I have discovered in operating upon patients whose lower pole vessels had been ligated elsewhere.

Ligation of all the main thyroid vessels I have also not employed, because, as shown many years ago by the fundamental experimental studies of my former chief, Dr. William S. Halsted, at least one pole of the thyroid must be left with unimpaired blood supply if normal function is to be maintained.

In this connection it may not be out of place to mention two little-used **criteria** in estimating the fitness of extremely toxic patients for any surgery; the differential blood count, and the pulse deficit chart. These we have found of sufficient value so that we record them along with basal metabolism and pulse rate. Cabot mentioned the association of lymphocytosis with exophthalmic goitre, in an early edition of his book on the blood; and Kocher considered the blood examination of considerable value. While not of as much value as some other data, the blood report helps to make up the complete clinical picture, from which we decide what it is best to do or leave undone, and ordinarily it checks up in fair accord with the other clinical tests. A pulse deficit chart, or some other means of regularly recording the relation of the apex beat to the pulse, seems to me of far greater value. Any persistent discrepancy between the apex beat and the radial pulse in a patient who has had fairly prolonged rest, with digitalization and other preliminary treatment, we have considered sufficient evidence of myocardial insufficiency to make even the least of the many-stage procedures too hazardous in practically all cases. To be of value, the record should be made by a specially instructed and intelligent nurse, or by a doctor. Many untrained pupil nurses do not use a stethoscope well enough to record the heart accurately. When accurately charted, it gives at a glance, knowledge

of first importance. Fortunately the heart condition, and deficit chart which records it, improve, in the majority of cases, under suitable preliminary rest and care.

In conclusion, to emphasize a few points in this brief paper which seem to me important: operation divided into many independent stages not only makes it possible to save the lives of most of these desperately ill patients, but with the many-stage operation, it is easier to enforce the rest and care indispensable to ultimate complete recovery, especially in those cases with dilated hearts and myocardial degeneration.

The disadvantages of greater scarring, prolonged hospitalization, and increased expense, seem trivial when safety and permanent recovery are considered.

The advantages of preliminary ligation will be more fully realized when the pole of the gland is well exposed, so as to make certain the securing of all vessels, great and small, main and collateral.

Many-stage excision with wound packing is best reserved for the few cases in which it has proved impossible by careful preliminary study correctly to estimate the gravity of the patient's condition, and unexpected grave symptoms develop during operation. In such cases it saves life, and the disadvantages of slight risk of infection and additional scarring scarcely deserve consideration.

EVENTRATION OF THE DIAPHRAGM*

By MALVERN B. CLOPTON, M.D.

OF ST. LOUIS, MO.

I PRESENT two cases of a rare anatomical anomaly that offered interesting problems in diagnosis, that in one instance led to an operation that we believe was uncalled for, and in the other instance made us hesitate to operate because of the anomaly, and spared the child an unnecessary operation. Both children present the same findings. There is a high lying diaphragm on the left side, with the stomach, spleen and large bowel occupying the space usually filled by the lung. The heart is in the right chest. The stomach is large. The large bowel is also dilated and enlarged. The liver is vertical and right-sided. The chest wall shows a slight bulging of the lower half of the left side. This condition was designated as eventration of the diaphragm by Cruveilhier.

The first case, E. K., St. L. Ch. H., No. 16368, December 30, 1920, had been operated six months before admission to the hospital, at the age of fourteen months, when a part of the eighth rib on the left side was resected and a tube introduced. At that time the child had had influenza and bronchopneumonia followed by what was considered to be empyema. The drain had remained in place six months, and a week after it was removed an abscess formed along the tract forward of the fifth rib. At this time the child was brought to the hospital because the fever had been high, the thirst violent, and it had vomited everything for three days. The baby cried continuously for water, which it drank ravenously, only to vomit it immediately. The child's condition was pitiful. It was wasted, extremely restless, temperature elevated. Water was given by rectum and sodium bicarbonate and glucose intravenously and saline intraperitoneally. After twenty-four hours the anhydremia was relieved, and feeding was started through an in-lying duodenal tube. The sinus through the resected rib led into a small cavity, which was an extra-pleural abscess, and outside the fifth rib there was another abscess of the chest wall which extended forward. Except for noting that the heart was displaced to the right, the physical examination of the chest was unsatisfactory. The X-ray showed what we thought was a diaphragmatic hernia with part of the stomach in the chest. There was no obstruction to the oesophagus. A clear gas-filled area was seen bounded above by a clean-cut curved line and below by a horizontal fluid level. On shifting the child's body the fluid flowed into the clear space in the chest, so that when the patient was inverted the chest was filled with fluid, except for a small area above the rounded dome of the stomach which was occupied by the lung. The stomach was apparently divided into two compartments.

At first we thought that at the time the operation was performed for supposed empyema, six months before, the diaphragm had been opened near the costal attachments and the stomach had worked its way through. This opinion was later revised when we fortunately got the plate taken before the first operation, which shows the small lung space on the left, and lying beneath the intact diaphragm, a clear gas-filled space which evidently represents the stomach just

* Read before the American Surgical Association, June 1, 1923.



FIG. 1.—Case I. At time of death. Evertion of diaphragm was at first thought to be a hernia. Valve-like projection from the midline below the main mass, which simulated the diaphragm. Case had been operated on twice for supposed empyema. Note right-sided position of the heart.



FIG. 2.—Case 1. Taken with child on the side. Different levels of fluid in stomach due to air trapped in upper compartment by valve-like projection of stomach wall. Such a condition as might be seen in hernia, but intact diaphragm is seen above top of upper end of stomach.



FIG. 3. Case 1. Postoperative film (Fig. 1, 2) showing the outline of the diaphragm after the operation in the case of the prepared.



FIG. 4—Case II. Showing intact diaphragm on left side with stomach, large bowel and spleen lying below. Heart almost entirely right-sided. Liver vertical. Large bowel is redundant.

as is shown by our latest X-ray views of the child now well. We are of the opinion that the condition at present represents what was present before operation, and is a typical eventration of the diaphragm with the stomach of regular outline and the top of it covered by the very high lying diaphragm. The child was treated expectantly, the superficial infection cleared up and the sinuses closed. The stomach relieved of the surrounding inflammation began to function correctly and the child is now perfectly well. At the first operation either the stomach was perforated after opening the chest wall, or the incision had led into the peritoneal cavity.

The second case, R. D., St. L. Ch. H. No. 19145-M, August 3, 1922, is a boy six years old who had first been studied because of malnutrition. On examination the heart was found in the right chest, and in the left chest tympany extended up to the third rib in front and down to the level of the twelfth rib. A succussion sound was demonstrated over the tympany, and in the upright position a line of dullness was made out below, which disappeared when the child lay down, and this was considered stomach and not an encapsulated pyopneumothorax. The X-ray examination showed an atypical high diaphragm rising to the level of the second intercostal space and below this the stomach, with the œsophagus entering opposite the eighth vertebra. The colon also reached to the level of the diaphragm but was displaced when the stomach was full. The spleen, normal in size, was seen hugging the lateral wall. The liver, of normal size, was entirely right-sided and extended to the crest of the ilium. The heart was in the right thorax. The child was discharged under instructions as to diet, and gained in weight and strength.

Four months later he was brought back because of an attack of abdominal pain, which simulated appendicitis. In the afternoon he had severe epigastric pain which moved later to the lower abdomen. There was general abdominal tenderness, nausea, but no vomiting. When he entered the hospital a few hours later he had a temperature of 101 degrees, leucocytosis of 17,400, with abdominal pain, but there was no consistent point of tenderness, at times he was more tender in the right lower quadrant, and then over a corresponding point on the left side. After a very large spontaneous stool the child felt quite comfortable. Examination of the rectum showed it to be very large. The external sphincter was very weak or absent but the internal sphincter was tight. In this case as in the previous one, the large bowel was generally dilated and redundant, as shown in the X-ray. We concluded that he had the cramping and pain occasionally seen with these large bowel distentions and we deferred operation. The temperature was explained by a reddened throat. The next day the boy seemed well. After another study with the X-ray, the boy went home.

Under usual conditions neither child presents any untoward symptoms from their anatomical anomalies.

Cruveilhier, in 1849, credits J. L. Petit with having described this condition found at autopsy in which the diaphragm on the left side was distended, forming a high lying flask-shaped pouch. There was no rupture of its membrane, and the diaphragm was considered to have lost its power of contraction. The stomach, colon, omentum, and spleen occupied the space usually filled by the left lung. The heart was in the right chest. Others have since described the condition and there has been much discussion of the name. Wieting² gave the name "relaxatio diaphragmatis" and König³ "idiopathic high-lying diaphragm."

The condition is rare. When we compare these cases with hernias of the

diaphragm, we find according to Struppler,⁴ there are forty-four eventrations to five hundred hernias of the diaphragm. Before the X-ray there were few cases diagnosed. Up to 1899, Neumann⁵ found only eight cases in the literature and these were discovered accidentally at autopsy; since that time, up to 1919, forty-one cases have been reported of which nineteen have been confirmed by autopsy.

The condition is probably congenital in origin, at least it has been observed in very young children. There is a theory that is held by some that the diaphragm is paralyzed, due to the atrophy of the phrenic nerve, but in seven cases in which the nerve was examined, only four showed a decided change of this structure (Neumann). In both of our cases the diaphragm went through a typical excursion in the fluoroscopic examination, which differed from the opposite side only in being much more restricted. In many of the cases studied at autopsy, the diaphragm showed thinning and replacement of muscle tissue with fat.

Eventration occurs nearly always on the left side. In those cases in which the autopsy reports mention it, the lung is small but has two lobes.

This condition may exist without giving any symptoms, and advanced age may be reached without any evidence of trouble. Symptoms if present may be referred either to the chest or to the abdomen. Some cases have complained of discomfort in the left chest or have had a sense of pressure. Very rarely has there been any complaint of the heart which is pushed far to the right. Dyspnea is often noted with inflammation of the left lung, and distress follows coughing as in bronchitis. Frequently, there are digestive disorders, with distress after eating. Occasionally the kinking of the lower end of the œsophagus gives symptoms similar to cancer of the œsophagus. The stomach, which is larger than usual, may be the seat of hemorrhages, or volvulus may develop. The large intestine may be dilated and symptoms may arise similar to those in Hirschsprung's disease.

In making the diagnosis, it is most important to consider the variations shown by percussion and auscultation. The heart is found in the right side of the chest. A large part of the left chest is tympanitic, and there is a dullness which varies with position of the body and with taking of food and liquid. This shifting dullness of the partly filled stomach may be mistaken for pyopneumothorax, as in one of our cases. Succession if obtained must be located in the pleura or stomach, and the diagnosis cleared by the X-ray.

The chief confusion in diagnosis will be with diaphragmatic hernia. As both conditions may be congenital, and both exist for a long time without manifest symptoms, it is often impossible to distinguish between the two conditions without a thorough X-ray study. The continuity of the arch of the diaphragm in eventration or displacement marks the distinction between hernia, which, whether congenital or traumatic in origin, shows an irregularity in the diaphragm, and the mottled appearance of the lung may show through the gas contained in the stomach.

In a fluoroscopic examination the diaphragm moves with respiration, or



FIG. 1.—Case 1. Showing particularly marked herniation of the liver through the diaphragm.



FIG. 6.—Case II. Lateral view to show the diaphragm intact and its very high position.

the excursion may be much reduced due to congenital hypoplasia of the left lung. In diaphragmatic hernia a "paradoxical expiratory displacement" has been noted, with forced inspiration the herniated diaphragm ascends, and descends with expiration.

The displacement of the heart may confuse eventration with situs transversus, but further examination will show the liver to be right-sided, and the stomach on the left.

The prognosis in cases of eventration is good, and death has never been observed as a direct consequence of the condition. Complications arise from the involvement of the organs that enter into the abnormal displacement, but are rarely more serious than are seen with normally placed viscera.

Nothing much need be said about treatment, as what there is should be entirely symptomatic. Eventration is not an operable deformity, in contradistinction to diaphragmatic hernia, which most often is. But eventration has been operated upon because of a diagnosis mistaking it for pyopneumothorax as in our first case, and as in a case reported by McNab.

For the prevention of serious complications, severe exertion should be avoided.

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CARDIOPLASTY FOR CARDIOSPASM*

By STEPHEN H. WATTS, M.D.

OF CHARLOTTESVILLE, VA.

PROFESSOR OF SURGERY, UNIVERSITY OF VIRGINIA

THE etiology, diagnosis, and non-operative treatment of cardiospasm have been thoroughly discussed in recent years by Plummer, Smithies, and many others, but comparatively little has been written regarding the operative treatment of the condition. This is quite natural considering that very few of the cases require surgery for their relief, in fact it is possible that surgery is justifiable only where the hydrostatic dilator cannot be passed through the cardia with the aid of a silk thread guide, as in my case, but experience at the Mayo Clinic shows that this must be extremely rare. Vinson has reported a case with very marked dilatation and angulation of the cesophagus in which he was able to pass the dilator on a flexible bougie.

Since a radical operation at the cardia is a rather formidable procedure it might be advisable in the rare cases in which a silk thread cannot be gotten into the stomach by way of the mouth, to open the stomach, stretch the cardia and pass a strong thread backward through the cesophagus, bringing the lower end of the thread out through a gastrostomy and leaving it as a guide for the hydrostatic dilator to be passed by the mouth.

The cases with great dilatation and atony of the cesophagus might seem to indicate surgery, but it is said by Plummer and Vinson that these respond particularly well to hydrostatic dilatation; however, in my case, in spite of a large opening at the site of the cardioplasty, the cesophagus is still quite dilated more than a year after operation, but the symptoms are perfectly relieved.

J. C. Russel, in 1898, first dilated the cardia by means of a rubber bag covered with silk. This method has been perfected by Plummer and others and has become the standard method of treating cardiospasm.

Gastrostomy alone in this condition is only a palliative measure. The first operation for the relief of the cardiospasm was published in 1904 by Mikulicz, who opened the stomach and thoroughly stretched the cardia by means of a rubber-shod clamp introduced into it under guidance of the finger. He reported six cases treated in this manner with good results in five. The poor result in the other case was attributed to scar formation due to suppuration. Most of the operators who have used this method have reported only single cases and as a rule have substituted their fingers for the instrument in stretching the cardia. Schloffer in two cases very gradually dilated until five fingers were passed into the cardia. In spite of this thorough stretching there was a tendency to recurrence. After some months there were few or no clinical symptoms, but the X-ray showed some delay in the cesophagus.

* Read before the American Surgical Association, May 31, 1923.

Pamperl, in 1910, collected fourteen cases operated upon by the Mikulicz method, of which twelve were said to be cured and two improved. In addition to these he reported the two cases of Schloffer mentioned above. Thieding, in 1921, collected three more cases successfully treated by this method. The operation was somewhat modified by Kummell, who suggested that the stretching be done without opening the stomach by invaginating the stomach wall on the fingers. This has been tried twice with little or no success. In



FIG. 1.—August 30, 1919. Enormous dilatation of esophagus.

one of these cases, Schnielsenky was unable to dilate the cardia in this way, therefore he opened the stomach and stretched the cardia with forceps. The cesophagus was torn and the patient died. This seems to be the only case on record in which death was caused by the Mikulicz operation.

In 1907, Reisinger reported a case of enormously dilated cesophagus with cardiospasm, in which he exposed the cesophagus in the posterior mediastinum by rib resection with the idea of plicating the cesophagus. This was prevented by collapse of the patient. Several weeks later a strip of the cesophageal wall, 15 cm. long by 2 to 3 cm. wide, was excised and the cesophagus sutured. On account of the breaking down of the suture many operations

were required to secure permanent healing after many weeks. The condition of the patient was said to be finally greatly improved by the operation.

The operation of œsophageal plication devised by Reisinger was later done by Meyer transpleurally under differential pressure. The vagi were separated from the œsophagus and the latter plicated. He reported three cases. One case was greatly improved for a good while, in fact was considered cured, but later developed an œsophageal fistula and died about a

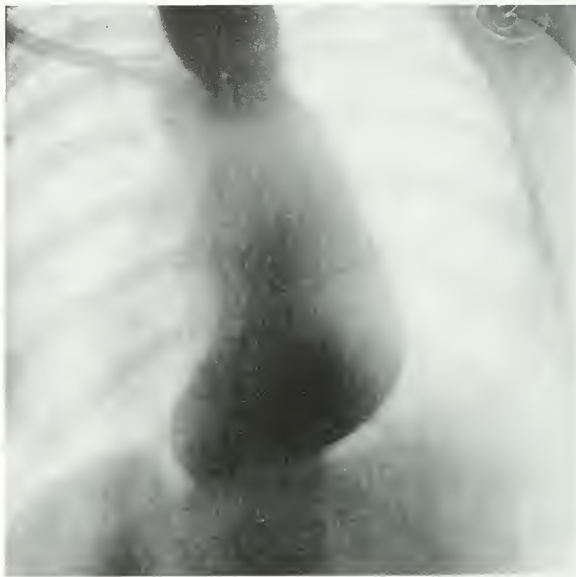


FIG. 2.—October 13, 1920. Practically no change. Very small stream of opaque meal passing into stomach.

year after operation of posterior mediastinitis. In the second case there was some improvement in swallowing immediately after the operation but the former difficulty gradually returned. In the third case there was no improvement.

Plication of the œsophagus would not seem to offer much hope of success in these cases as it does not remove the cause of the trouble.

In 1910, Wendel reported the first cardioplasty for cardiospasm. After turning up the costal margin he exposed the cardia, which was narrowed to the size of a lead pencil over an extent of 4 cm. A vertical incision was made through the anterior wall of the cardia and sutured transversely. The

patient was cured. My case seems to be the only other one in which this type of operation is reported and in my case the operation was more after the order of the Finney pyloroplasty. Meyer has done a transpleural cardioplasty four times in dogs, with recovery in each instance, and suggests that this may be the proper procedure in certain cases of cardiospasm.

In 1914, Heller described an extramucous cardioplasty and reported a case of chronic cardiospasm with dilatation of the esophagus treated in this



FIG. 3.—April 2, 1922. Three weeks after operation. In situ, a rubber-glass drainage
mal. Considerable dilatation of esophagus in situ.

manner. After turning up a flap of costal margin, the esophagus was freed by division of the peritoneum at the hiatus esophageus and by blunt dissection. It was drawn down and the musculature on the anterior and posterior aspects of the cardia was divided down to the submucosa over an extent of 8 cm. The day after operation, the patient could swallow any kind of nourishment without difficulty.

At the German Surgical Congress in 1921, Heller reported that this case was in good condition and free from symptoms seven years after operation, but the X-ray showed a constant narrowing at the cardia, of which there was no evidence just after the operation. He stated that he knew of

sixteen cases which had been operated upon in this way by various operators. There were no fatalities, the results were good in twelve cases and poor in four. One case of Zaaier developed a cicatricial contraction of the cardia which required an oesophago-gastrostomy. Heller says that division of the musculature is not difficult but that the operation should not be done in early cases without marked dilatation of the lower oesophagus.

Herovsky, in 1913, reported a case operated upon in the following man-

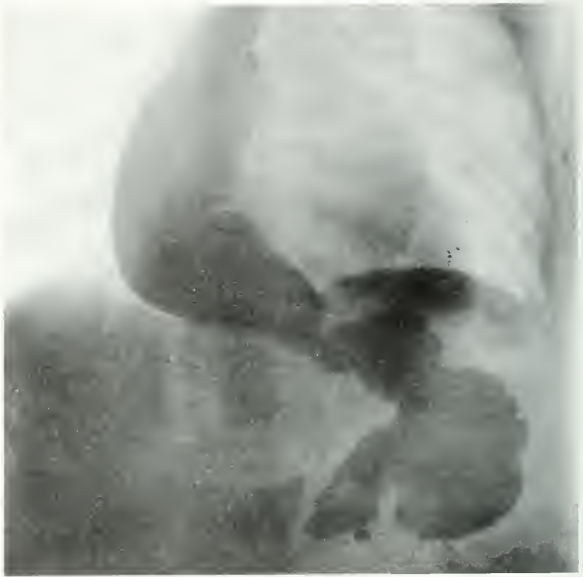


FIG. 4.—September 15, 1922. Six months after cardioplasty. Note marked shrinkage of oesophagus, the large opening at the cardia and the well filled stomach.

ner. After turning up the costal margin the oesophagus was loosened at the hiatus and anastomosed to the fundus of the stomach by suture. The patient was completely relieved. Later oesophago-gastrostomy for cardiospasm was done by Exner, Enderlin, Finsterer, Sauerbruch and a few others with rather satisfactory results. Of the three cases thus treated in Sauerbruch's clinic one died and the other two were greatly benefited. In 1914, Röpke, after making a costal flap, mobilized the oesophagus at the hiatus oesophageus, drew it down about 10 cm. into the abdomen, removed the periesophageal tissue down to the musculature by blunt dissection and then incised the anterior edge of the hiatus. After this operation any kind

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of food could be taken. Borchgrevink reports a case in which this operation was followed by sounding with perforation and death.

Resection of the cardia for cardiospasm, as proposed by Rumpel in 1897, has apparently not yet been done.

From this review it would seem that the simplest operative measure is stretching the cardia by way of the stomach, but this may be followed by a recurrence. The extramucous cardioplasty of Heller is probably the simplest



FIG. 5.—May 5, 1923. Practically no change since last picture.

and best radical operation, if it is as easy and efficient as the reports would lead us to believe. A cardioplasty, resembling the Finney pyloroplasty, as done in my case, would probably not be difficult in cases where the dilated œsophagus bulges through the hiatus, provided the costal margin is turned up to secure a better exposure, but the possibility of infection here presents an element of danger.

Case Report.—Mrs. M. D., white, aged thirty-nine years, was first admitted to the University of Virginia Hospital, August 27, 1919, complaining of shortness of breath and regurgitation of food. *Family History.*—Unimportant. *Previous History.*—Unimportant. *Present Illness.*—About fifteen years ago patient began to feel as if there were a lump in her throat after eating, as though the food had lodged behind the lower end of the sternum. Soon after this she began to

regurgitate her food. The condition gradually grew worse with increasing difficulty in getting food into the stomach. At the present time she eats about one-half of her meal then drinks about a quart of water, finishes the meal and drinks more water.

The regurgitated food comes back just as it was eaten; milk comes back thick but not sour. Most of the food comes back in from five to fifteen minutes after eating but some of it comes back at irregular intervals until the next meal.



FIG. 6. May 5, 1923. Small amount of opaque meal in lower esophagus one-half hour after meal.

Often a part of her supper comes back the next morning just as it was eaten the night before.

The patient at this time was fairly well nourished. The X-ray photograph after giving one quart of opaque meal showed an enormous dilatation of the esophagus, tapering down to a sharp point at the cardia and none of the barium was in the stomach (Fig. 1.). She left the hospital without treatment promising to return in two weeks for dilatation, however she did not come back for a year, *i. e.*, September 13, 1920. She had lost considerable weight and she had still more difficulty in getting food into the stomach, in fact she often found it necessary to make pressure in the suprasternal notch, where there was a distinct fullness. The X-ray examination gave the same picture as described above. Numerous attempts to pass bougies and to have her swallow a thread were unsuccessful, so she was transferred to the surgical service.

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Operation (September 24, 1920).—*Gastrotomy; digital stretching of cardia, gastrostomy.* Incision was made through the upper portion of the left rectus muscle. The stomach was somewhat contracted but nothing like so much as had been expected. Examination of the cardia showed it to be quite narrow, apparently in spasm, but an interesting point was that about 4 cm. of the dilated œsophagus could be seen below the diaphragm. Cardioplasty was considered but was given up on account of the rather inaccessible location of the cardia. The stomach was opened near the cardia and two fingers were easily passed through the cardia which was stretched by separating the fingers. The opening in the stomach was closed and a Frank gastrostomy was done with the idea of thus feeding the patient and allowing the greatly distended œsophagus to contract.

The patient's condition was slightly but temporarily improved by this operation, perhaps due to insufficient stretching of the cardia. X-ray, October 13, 1920, (Fig. 2.) showed only a very small amount of the opaque meal passing into the stomach. She became dissatisfied, complained of pain caused by the gastrostomy tube, demanded its removal and left the hospital.

She came to the hospital again about a year later, November 9, 1921, complaining of inability to get food into the stomach, of sore mouth and sore, swollen hands. About three months before, when she was weighing 130 pounds, she became unable to force food into the stomach as she had formerly done, her mouth soon became sore and her hands and arms seemed inflamed. Her hands became worse, swollen, dry and cracked. She developed a diarrhoea, lost weight rapidly and became greatly depressed mentally.

Her weight on admission was seventy pounds. There was a glove-like area of dermatitis, involving the dorsum of the fingers, hands and forearms, extending to within three inches of the elbow. It was symmetrical on the two sides. The skin was thickened, rough, brownish, inelastic, scaly, and fissured, and the edge of the involved area was sharply demarcated. There was moderately marked stomatitis, involving chiefly the tongue, which was red, furrowed and swollen. There were all the cardinal symptoms, nervous, cutaneous, gastro-intestinal, and metabolic, of pellagra.

The gastrostomy was reopened on November 15, 1921, and a tube reinserted. She was given a diet with a high protein and vitamins, especially water soluble vitamins three, content. She improved rapidly and symptoms of pellagra gradually disappeared. In three months she had gained sixty pounds and weighed 130 pounds.

X-ray picture at this time was practically the same as on her first admission and attempts to pass an œsophageal dilator were again unsuccessful. At her urgent request a radical operation was undertaken.

Operation (March 13, 1922).—*Cardioplasty for Cardiospasm.*—Incision was made through the old scar and the stomach separated from the abdominal wall, an opening 4 cm. long being left in the stomach at the site of the gastrostomy. Numerous adhesions were encountered in the upper left abdomen but with considerable difficulty these were separated and the cardia exposed. It seemed rather narrow and the bulging œsophagus could be seen above it. An incision 4 cm. in length was made through the anterior aspect of the cardia, extending equally into the œsophagus and stomach. These structures were approximated and sutured together with chromic gut very much after the manner of a Finney pyloroplasty. The old gastrostomy opening was closed and a new Frank gastrostomy made. A cigarette drain was inserted through a stab wound in the left flank and the abdomen closed.

She made an excellent recovery, in two weeks was able to take any kind of soft diet and it was then unnecessary to use the gastrostomy. X-ray picture (Fig. 3)

taken immediately after the giving of the opaque meal on April 2, 1922, three weeks after the operation, showed a considerable amount in the stomach.

She left the hospital April 29, 1922 and since that time has had no trouble whatever referable to her œsophagus, though she did enter the hospital about a month later with a definite appendix abscess which was absorbed without operation.

X-ray picture, September 15, 1922, (Fig. 4) showed marked shrinkage of the œsophagus, a large opening at the cardia, and a well filled stomach. The patient was last seen on May 5, 1923 when she stated that she was perfectly well and could swallow any kind of food without difficulty. Her weight was 166 pounds. X-ray gave practically the same picture (Fig. 5.) as in September, 1922, and we were somewhat disappointed that there had apparently been little or no further shrinkage of the œsophagus. The picture one-half hour after the meal (Fig. 6) showed a small amount of the meal in the lower œsophagus.

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AN OPERATION FOR THE RELIEF OF CARDIOSPASM ASSOCIATED WITH DILATATION AND TORTUOSITY OF THE OESOPHAGUS*

BY LEONARD FREEMAN, M.D.

OF DENVER, COLO.

ABOUT twenty years ago, a man, thirty-four years of age, came under my care for a severe cardiospasm, which had seriously annoyed him for ten years. Although there had been intervals when he could swallow reasonably well, nevertheless the trouble had steadily increased until he could not be sure of swallowing anything but liquids, and these only with great and prolonged effort. He had become so extremely weak and emaciated that he could accomplish no sort of labor, and it was with the greatest difficulty only that he could get about at all. Profuse salivation, especially at night, and frequent, copious emesis, from the dilated oesophagus, were among the annoying symptoms.

There was no evidence of cancer or other form of tumor in connection with the oesophagus; neither was there a history of syphilis, typhoid, diphtheria, or injury by any corrosive substance, or anything else that might have caused the formation of a stricture. In addition to this, a large gastric tube could at all times be passed into the stomach without much difficulty.

The character of the symptoms, together with the permeability of the canal and the length of time during which the lesion had persisted, pointed either to a cardiospasm with much dilatation or to a large low-lying diverticulum. The X-ray, at that time, not being available for more accurate diagnosis, an exploratory operation was decided upon.

Operation (July 14, 1902).—The oesophagus was easily uncovered through the usual vertical incision on the left side of the base of the neck. No diverticulum was found; but, beginning just above the cricoid and extending further down behind the sternum than the finger could reach, the oesophagus was uniformly dilated into a great, slack, thin-walled, sac-like tube, around which the examining finger easily could be swept within the mediastinum.

Still searching for a possible diverticulum, which did not exist, I pulled upwards on the dilated tube until a large fold, including the entire circumference, protruded through the incision in the neck, and the portion below was rendered quite taut. There was no difficulty in accomplishing this, owing to the surprisingly loose manner in which the oesophagus seemed to hang within the mediastinum.

Having arrived at this point, with the loop of oesophagus lying exposed upon the neck, I was embarrassed as to what to do next. I did not want to resect the loop, because of the danger of infection, and yet the situation called for action of some sort. Finally it was decided to invaginate the upper segment of the loop into the lower, without opening its lumen, thus restoring to the tube something of its proper length and longitudinal tension. This intussusception, maintained by means of a few stitches of chromic gut, formed such a bunch in the oesophagus that I feared its complete occlusion, so a stomach-tube was passed and left in place for a few days, although I now question the necessity of such a procedure.

The wound was closed and healed by primary union. The patient soon recovered his full ability to swallow and in a few weeks had regained his strength and

* Read before the American Surgical Association, May 31, 1923.

energy. Up to the present time, twenty years, he has had no return of his trouble except an occasional slight dysphagia. He has been able to live his life and do his work with ease and comfort.

The outcome of this case perplexed me much. It seemed evident that the operation had brought about a cure, but I did not understand how. If the trouble always was due to a spasm of the cardiac muscle, as believed at that time, why should it be cured by a mere invagination of the dilated œsophagus higher up? Finally I connected it up vaguely with the shortening and narrowing of the œsophagus and let it go at that. I did not report the occurrence, because I did not clearly understand it.

Recently I came across an article by Herman Kümmell (*Archiv klin. Chir.*, B. 117, H. 2, p. 193.) which throws light upon the subject and has given me a new interest in it. Among other things he emphasized the tendency to failure of the current forms of treatment, such as the various methods of dilatation from above and from below, the division of the sphincter muscle, etc. But my attention was attracted particularly to a paragraph dealing with the pathology of the affection, in which it is stated that the difficulty in swallowing may be due to either of two conditions or to their combination. One of these is cardiospasm, followed more or less closely by dilatation; and the other is where the œsophagus is not only dilated, but also convoluted, as though it were much too long for the mediastinum. This latter form, often of congenital origin, may or may not be preceded or accompanied by spasm of the cardiac muscle, the difficulty in swallowing being due more to the peculiarities of the dilated and convoluted tube than to the muscular spasm of its outlet.

Kümmell then recounts a case of the second variety in which, after the failure of other treatments, he attempted to obtain a cure by opening the abdomen, loosening the cardia from its diaphragmatic connection, pulling down the redundant œsophagus, dividing it at the stomach, and anastomosing it with the jejunum. The stomach itself he shifted upwards to the neck, through a subcutaneous tunnel over the sternum, with the intention of ultimately uniting it to the cervical œsophagus. But for some reason this highly ingenious and complicated procedure failed to produce a permanent result, although the patient was fortunate enough to survive. A number of similar operations also have been done, with more or less success, by various other surgeons (Sencert, Oettinger, Caballero, Sauerbruch, Exner, Tuffier, etc.), having the common objective of straightening out the œsophagus by pulling its redundant portion down into the abdominal cavity and perhaps anastomosing it to the stomach or to the duodenum. Reisinger plicated the œsophagus, with an indifferent result, through an opening into the posterior mediastinum, the operation being done in two stages owing to the collapse of the patient. Willy Meyer, in the *International Journal of Surgery*, 1912, describes two longitudinal plications done by the transpleural route, the results being rather unsatisfactory. More recently, Priham (*Archiv klin. Chir.*, 1922, B. 120, H. 2, p. 207) says, "It might also be considered if one could not.

after exposure and mobilization of the cesophagus in the neck, pull it upwards and thus do away with its tortuosity. A resection of the cesophagus in the neck would be accompanied by but little danger" [!] He adds, however, that this has not yet been tried.

If the assertion of Kümmell is true that the dysphagia in some instances is due more to undue length and tortuosity of the gullet than to spasm of the cardia, the satisfactory result obtained in my own case by telescoping the cesophagus into itself is easily understood. By means of this procedure, not only was the length of the tube lessened and its tortuosity removed, but at least a portion of its calibre was considerably diminished, thus increasing the muscular tone and doing away with obstruction arising from the slack folds. At any rate the effect was good and permanent. The operation also has the advantage of simplicity and safety, the danger of infection practically being absent, because it is unnecessary to open the cesophagus. To be sure, one case does not prove much, but I venture to report it in the hope that further experience with the method may show it to be of value under appropriate circumstances.

PANCREATIC ASTHENIA AS A POST-OPERATIVE COMPLICATION IN PATIENTS WITH LESIONS OF THE PANCREAS*

BY ALLEN O. WHIPPLE, M.D.

OF NEW YORK, N. Y.

FROM THE SURGICAL SERVICE OF THE PRESBYTERIAN HOSPITAL, SURGICAL DEPARTMENT OF COLLEGE OF PHYSICIANS
AND SURGEONS, COLUMBIA UNIVERSITY

CERTAIN symptoms have been recognized for many years as occurring in pancreatic disease. These are asthenia, anorexia, nausea and vomiting, a tendency to hemorrhage, ptyalism, abnormal stools, epigastric pain and tenderness and rapid emaciation. One or more of these symptoms are mentioned by the numerous investigators in their discussions of the clinical picture of inflammatory and neoplastic lesions of the pancreas. But so far as the writer has been able to determine in a review of the literature a group of these symptoms has not been described as a syndrome appearing as a post-operative complication in the surgical therapy of the biliary tract and pancreas. In discussing the subject with several of the members of this Association, it is evident that this symptom complex has been noted by many of them and is considered a puzzling and difficult problem in the post-operative therapy of their biliary cases.

I desire to present an analysis of 18 cases with this complication from the Surgical Service of the Presbyterian Hospital, New York City. Seventeen of these patients were under my care, the eighteenth was recently operated upon by Dr. F. B. St. John and is included in this series with his kind permission.

In a series of 230 consecutive unselected cases of diseases of the biliary tract and pancreas operated upon by the writer, special attention has been paid to the pathology, symptoms, complications and results as related to the pancreas. Of these 230 cases 40 showed definite pancreatic lesions. The cases with questionable or moderate thickening of the pancreatic tissue about the common duct are not included. (See Table I.) Eighteen of these cases presented the complication which because of its most striking and constant symptom, asthenia, has been named pancreatic asthenia. At the Presbyterian Hospital we regard it as an entity. It is characterized by extreme asthenia, anorexia—in some cases a very loathing for all food, apathy, nausea and vomiting, a marked drop in blood-pressure, rapid loss of weight. In some cases there has been noted in addition a tendency to hemorrhage, with and without jaundice or biliary fistula, ptyalism, pain and tenderness over the pancreas, obstipation and diarrhoea. (See Table II.)

Pancreatic asthenia has appeared in our cases at intervals after operation varying from the second to the ninth day, and has lasted for periods varying

* Read before the American Surgical Association, June 1, 1923.

PANCREATIC ASTHENIA

TABLE I

Pathology of the 40 Cases with Pancreatic Lesions

<i>Acute inflammatory lesions.</i>	7
Hemorrhagic pancreatitis	2
Suppurative pancreatitis with fat necrosis	4
Abscess of the pancreas	1
<i>Chronic inflammatory lesions</i>	17
Chronic pancreatitis without cholecystitis or cholelithiasis	4
Chronic pancreatitis with cholecystitis and cholelithiasis	7
Pancreatic lymphangitis involving the entire head with cholecystitis and cholelithiasis	6
Diabetes mellitus with cholecystitis and cholelithiasis	5
Carcinoma of the pancreas	11
Primary carcinoma of the pancreas	8
Primary carcinoma of the gall-bladder with metastases to the pancreas ..	2
Primary carcinoma of the stomach with metastasis to the pancreas	1

TABLE II

Analysis of Symptoms in 18 Cases of Pancreatic Asthenia

Asthenia was present in 18 cases.
Anorexia was present in 18 cases.
Apathy was present in 15 cases.
Nausea and vomiting was present in 18 cases.
Loss of weight was present in 18 cases.
Marked and continued fall in blood pressure was found in all of the last 7 cases on whom daily determinations were made.
Tendency to hemorrhage present in 6 cases.
Ptyalism present in 2 cases.
Pain and tenderness over the pancreas present in 3 cases.
Jaundice appeared after operation, present in 5 cases.
Obstipation was present in 2 cases.
Diarrhœa was present in 2 cases.

from two to thirty days, the average period being twelve days. The symptoms appear, as a rule, after the patient has recovered from the shock of the operation, when he is apparently doing well. In the patients recovering from this condition the change for the better is often surprisingly abrupt, appearing with a sudden return of appetite and relish for food. It differs from the cholemic state that one sees in cases with long-standing biliary obstruction and damaged liver. These patients with pancreatic asthenia are never comatose. They maintain a clear sensorium, are never delirious. Languor and apathy are pronounced. Weakness is their chief complaint. Asthenia, anorexia, nausea, drop in blood-pressure have been the first symptoms to appear. The asthenia is as marked in some cases as it is in Addison's disease. It is a subjective symptom causing the patient real concern. It is objectively manifested by the muscular relaxation, the mask-like facial expression, the feeble drawling voice, the weakened grip. All effort is avoided. Treatments are dreaded and exhausting. Oser, in his monograph on pancreatic disease, described this asthenia, but not in the post-operative

period. In discussing Chronic Indurative Pancreatitis he says:¹ "It is a well-known fact that many patients suffering from gall-stone, even without permanent jaundice, become so very weak and rapidly emaciated that the development of cancer is suspected, and yet after a long time patients wholly recover." Again in discussing asthenia in carcinoma of the pancreas, he remarks: "One peculiarity especially is frequently pronounced and manifest in the cachexia caused by pancreatic cancer, namely, the great weakness and prostration which cannot be explained by the inanition alone. The sensation of weakness may be too great for words—the patient avoids expression of suffering because it is worse to bear than the violent pain. The patients lie quiet and apathetic."² Apathy and languor have been noted in all of our cases, and is considered a result of the asthenia.

Anorexia is a constant symptom. In several of our patients there has been an aversion for all food, even fluids. This has been noted as independent of the nausea. Oser,³ in speaking of anorexia in pancreatic disease, mentions "a loathing for food, especially for meats." Nausea and vomiting may be very marked; it has been present in all of our cases and has complicated the maintaining of fluid intake.

Blood-pressure studies have been carried out in our last seven cases. There has been a constant finding of marked drop in blood-pressure readings during the pancreatic asthenia as compared to the pre-operative readings. In one patient with a pressure of 215/130 before operation readings of 110/80 to 120/80 were noted during the course of her asthenia which lasted three weeks. Subsequent to her leaving the hospital her pressure rose to 200/120. In another patient pre-operative readings showed 110/70. During the most marked manifestations of his asthenia his systolic pressure fell to 50 with an imperceptible diastolic. No other observations on low blood-pressure in pancreatic disease after operation have been found in the literature.

A tendency to hemorrhage has been noted in two of our cases without jaundice, in four with jaundice. Prolonged bleeding and clotting time was a serious complication in these six cases. Jaundice appeared for a few days during the period of asthenia in four of our cases in whom stones were not found in gall-bladder or ducts at time of operation. In one of these patients jaundice continued for almost two years after the onset of the pancreatic complication. Ptyalism or excessive salivation was present in two of our cases during the pancreatic asthenia. This symptom is one of the earliest attributed to pancreatic disease. Schmackpfeffer,⁴ in 1817, first called attention to it. Battersby,⁵ in 1844, noted ptyalism in a case of pancreatic cyst, as did Ludolf,⁶ in 1890. Halzmann,⁷ in 1894, Caparelli,⁸ in 1892, Guidiceandra,⁹ in 1896, discussed this symptom in cases of pancreatic calculus. Friedrich,¹⁰ in 1878, considered it a result of stomach involvement. Oser¹¹ explains it on the basis of associated nausea. A low sugar tolerance was determined in one of the eighteen cases after the asthenia disappeared. Pancreatic asthenia did not occur, however, in any of the five diabetics operated upon for gall-stone disease.

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TABLE III

Analysis of Pathological Findings in 18 Cases of Pancreatic Asthenia

Case	Operative findings and operation	Result	Autopsy findings
1	Abscess in head of pancreas. Drainage of abscess.	Recovery 24 mos.	
2	Chronic pancreatitis involving the entire pancreas. Gall-bladder full of calculi. Cholecystectomy, choledochostomy.	Died	Hemorrhage in the interlobular septa. Ducts dilated. Acute interstitial pancreatitis.
3	Fat necrosis in omentum. Head of pancreas hard, nodular œdematous. gall-stones in the gall-bladder and common duct, cholecystectomy, choledochostomy.	Recovery 19 mos.	
4	Chronic cholecystitis. No calculi were found in gall-bladder or ducts. Lymph-nodes were enlarged along cystic and common ducts. Lymphangitis of the head of the pancreas. Cholecystectomy, appendicectomy.		She developed jaundice with asthenia and loss of weight. Lived 26 months. Died of chronic pancreatitis. Autopsy not obtained.
5	Chronic cholecystitis, calculi in gall-bladder and common duct. Entire pancreas was markedly enlarged, œdematous, indurated. Nodes were enlarged along the duct and over the head of the pancreas. Cholecystectomy, choledochostomy.	Died 20th day	Pancreas firm, nodular, enlarged, considerable increase in the interlobular connective tissue, especially in the body and tail.
6	Chronic cholecystitis, calculi in gall-bladder, one in common duct. The entire pancreas was hard, nodular, enlarged throughout. Cholecystectomy, choledochostomy.	Recovery 17 mos.	
7	Hydrops of gall-bladder. No calculi, common duct dilated, no calculi, pancreas showed a large, hard, nodular head with a cyst in its upper aspect. Cholecystoduodenostomy.	Died	Patient recovered after her pancreatic asthenia. Tumor mass which had been palpable before operation disappeared in epigastrium for several months. Symptoms of asthenia recurred at end of 18 months and she died one month later. Autopsy not obtained as she died in a small suburb.

Case	Operative findings and operation	Result	Autopsy findings
8	Acute and chronic cholecystitis. Chronic cholangitis (<i>B. coli communis</i>). Calculi in gall-bladder and common duct. Enlarged nodes along common duct and over head of pancreas. Lymphangitis of entire head of pancreas. Cholecystectomy, choledochostomy.	Recovery 42 mos.	
9	Walls of gall-bladder calcareous gall-stone 5 x 4 x 4 cm. occupied the shrunken gall-bladder and compressed the common duct. Lymphangitis of the head of pancreas. She had been jaundiced eight months. Liver markedly enlarged. Cholecystostomy.	Recovery 56 mos.	
10	Chronic cholecystitis. Calculi in gall-bladder and common duct, lymphangitis of entire head of the pancreas. Cholecystectomy, choledochostomy.		
11	Chronic cholecystitis. Chronic pancreatitis, entire head and tail hard, nodular and enlarged. Cholecystectomy, choledochostomy.	Recovered 21 mos.	
12	Chronic cholecystitis. Single cholesterol stone in gall-bladder, 2 months pregnancy. Cholecystectomy.	Died 28th day	Developed pancreatic asthenia with jaundice on 2nd day. This persisted until 26th day. She then had very severe epigastric pain, developed hemorrhage and went into collapse. Autopsy.—Acute diffuse cholangitis hematoma in submucosa of the duodenum, closing lumen of the bowel. Hemorrhages into the retroperitoneal tissues. Fat necrosis. Sclerosis of pancreas with hemorrhage in it.
13	Gall-bladder distended, acutely inflamed. No calculi found in gall-bladder or ducts. Head of pancreas very hard, nodular, common duct dilated. Diagnosis: Acute cholecystitis carcinoma of pancreas. Cholecystectomy, choledochostomy.	Died 14th day	She showed hemorrhages into bowel and subcutaneous tissues.

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Case	Operative findings and operation	Result	Autopsy findings
14	Carcinoma of gall-bladder. Chronic cholecystitis. Calculi in gall-bladder. Chronic pancreatitis. Cholecystectomy, transduodenal. Choledochostomy.	Died 19th day	<i>Autopsy.</i> Chronic pancreatitis, acute pancreatitis. Necrosis and liquefaction of periduodenal tissue and duct of Wirsung. Carcinoma of pancreas, liver, ovary and adrenal.
15	Carcinoma of body of pancreas. Exploratory celiotomy.	Died 15th day	
16	Carcinoma of pancreas. Cholecystgastrostomy.	Died 2nd day	
17	Carcinoma of gall-bladder. Carcinoma of common duct. Calculi in gall-bladder. Cholecystectomy, choledochostomy.		She developed typical pancreatic asthenia on 2nd day. These symptoms continued for 16 days, when she was taken to her home by her family. She died 2 mos. later. Whether or not the pancreas was involved in this case not determined, as autopsy was not obtainable.
18	Carcinoma of pancreas, cholecystostomy.	Died 20th day	

Course of the Complication.—The symptoms showed a duration of 2 to 30 days, the average period being 12 days. Save in carcinoma cases the syndrome cleared abruptly with the return of appetite. In several of the cases this change was striking. The request for bizarre dishes is often the first indication of subjective improvement. Thus Case I, after three weeks of refusing all food, even the simplest fluids, one morning informed us she was hungry and desired a dish of tripe. When this was prepared by her daughter she ate it with gusto and proceeded to an uninterrupted recovery. Case VI, after eleven days of complete anorexia, asked for a piece of juicy steak. He recovered progressively thereafter. The rapid gain in weight and sense of well-being have in several of our cases been as striking as was the loss of weight, asthenia and apathy during the course of the complication.

Pathology.—The pathological findings in these eighteen cases as determined at operation or post-mortem have been variable and in several of the cases very puzzling. Speculation as to the pathological findings in a given case of pancreatic disease is as hazardous to-day as in Fitz's time, who after 27 years of investigating, in his masterly way, the pathology of the pancreas remarked¹² in 1903 that "morbid changes in the pancreas are found frequently after death without symptoms having been observed during life to

indicate their presence. On the other hand, the diagnosis of probable pancreatic disease, perhaps of the gravest sort, has been made from the recognition of one or more symptoms or signs which at times have been associated with alterations of the pancreas and the patient has recovered or the gland when exposed has presented no abnormal appearance." Yet it will be seen from the analysis of the pathological findings in Table III that definite pathology was found in the pancreas in all but Case XVII. Whether or not the carcinoma of the common duct in this case, found near the lower end of the duct, extended into the pancreas was not determined at the operation. The patient died at home two months after leaving the hospital and autopsy was not obtained.

Treatment.—This is largely directed to the relief of fluid depletion. Continual vomiting and disinclination to take fluids results in low urine output and nitrogen retention. Glucose infusions in 5 to 10 per cent. solutions have been well taken without glycosuria. This would indicate that the islands of Langerhans are not involved in these pancreatic lesions. Blood transfusion has tided over several of our cases during the critical period of asthenia, especially those in whom it has persisted for more than 10 days. Lavage of the stomach, with hot saline solution or tap water, has not controlled the vomiting as effectively as in other abdominal cases where ileus or gastric dilatation is a factor. For the tendency to hemorrhage we have

TABLE IV

Mortality Statistics in 18 Cases of Pancreatic Asthenia

Case 2	Died 14 day	Acute pancreatitis found at autopsy.
Case 5	Died 20 day	Chronic pancreatitis found at autopsy.
Case 12	Died 28 day	Acute pancreatitis found at autopsy. Acute ileus.
Case 13	Died 14 day	Carcinoma of pancreas found at operation. Hemorrhages into bowel, and subcutaneous tissue.
Case 14	Died 19 day	Carcinoma of gall-bladder found at autopsy. Chronic pancreatitis.
Case 15	Died 15 day	Carcinoma of body of pancreas found at operation.
Case 16	Died 2 day	Carcinoma of pancreas found at operation.
Case 18	Died	Carcinoma of pancreas found at operation.

Post-operative results in the 10 cases leaving the hospital

Case 1	24 mos.
Case 3	19 mos.
Case 4	Died at end of 26 months of a chronic pancreatitis.
Case 6	14 mos. 244 Has weakness in the scar.
Case 7	18 mos. after operation tender mass reappeared in the epigastrium with jaundice and asthenia. Died one month later.
Case 8	42 mos.
Case 9	56 mos.
Case 10	12 mos.
Case 11	24 mos.
Case 17	Died 2 mos. after leaving the hospital of carcinoma.

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found ¹⁸ intravenous infusions of calcium lactate in 0.2 to 0.5 per cent. solution shortened the bleeding and clotting time and has controlled the hemorrhage in all but three cases, all of whom showed carcinoma of the pancreas.

Epigastric pain and tenderness is best relieved with poultices. Tympanites responds to hot colon irrigations in some, to medicated enemas in others. We have found digitalis in the form of digitan given by rectum in 10 c.c. doses, has improved the general vasomotor and intestinal tone in a number of our cases.

Results.—It will be seen from Table IV that of 18 patients showing this syndrome 8 died while in the hospital, 5 showing carcinoma; 3 died after leaving the hospital in from 2 to 26 months. All of the surviving 7 patients show a symptomatic 4. relief from all symptoms, from 12 to 56 months after operation. From Table V it is evident that the lesions of the pancreas increase to a marked degree the hazard of the surgery of the biliary tract. In the entire series of 230 cases analyzed there were 25 deaths in the hospital, of these 25 fatal cases 15, or 60 per cent., showed pancreatic involvement. (See Table V.) Of 172 cholecystectomies, however, with the pathology limited to the gall-bladder at time of operation, there was but one death—Case XII reported in the series with pancreatic asthenia—the result of an acute pancreatitis developing after operation.

TABLE V

Death Analysis in 25 post-operative deaths in a series of 230 patients operated upon for Disease of the Biliary Tract and Pancreas.

15 of these cases showed pancreatic involvement.

11 showed carcinoma of the pancreas.

2 showed acute pancreatitis.

2 showed chronic pancreatitis.

Of the remaining 10 cases,

1 showed carcinoma of the cystic duct.

1 died of sepsis with *B. coli* chronic cholangitis.

3 died of cholemia with long standing biliary cirrhosis and common duct stone obstruction.

1 died of uremia following secondary cholecystectomy for common duct stone.

1 died of Welch bacillus cholecystitis and cellulitis.

1 died of vibron septique cholangitis and cellulitis.

1 died of *B. coli* bacteria and acute endocarditis.

1 died of multiple liver abscess.

In 172 cholecystectomies for inflammatory disease or calculus limited to the gall-bladder there was but one death, the result of an acute pancreatitis developing after operation.

CONCLUSIONS

1. There is a group of symptoms appearing as a post-operative complication in patients with pancreatic lesions, characterized by asthenia, anorexia, nausea and vomiting, low blood-pressure and rapid loss of weight.

2. In a series of 18 cases reported definite pathology of the pancreas was determined in 17 either at operation or post-mortem.

3. The asthenia, anorexia, low blood-pressure and loss of weight is not dependent upon malignancy, inasmuch as 12 of the 18 cases reported showed pancreatitis rather than carcinoma.

4. The involvement of the pancreas increases to a marked degree the hazard of biliary surgery.

5. The inflammatory lesions and calculus formation limited to the gall-bladder should be treated surgically before the process of inflammation extends to the pancreas.

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SPLENECTOMY IN HEMORRHAGIC PURPURA*

IDIOPATHIC PURPURA, ESSENTIAL THROMBOPENIE (FRANK). PURPURA
HEMORRHAGIC PROTOPATHIQUE (HAYEM)

BY JAMES MORLEY HITZROT, M.D.

OF NEW YORK, N. Y.

THE hemorrhagic diatheses have always been of considerable importance to the surgeon, because of the bleeding which occurs in these conditions following simple surgical procedures. This interest has recently been stimulated by Kaznelson, who recommended splenectomy upon a patient with essentielle thrombopenie (Frank) in October, 1916, with rather striking results.

Hayem has given a fairly definite set of clinical phenomena as characteristic of essential or idiopathic purpura (*purpura hemorrhagique protopathique*). The patient has an anæmia of the secondary type, with multiple spontaneous hemorrhages into the skin, from the mucous membranes, etc., recurring at irregular intervals with the following essential features: 1. Absence of any changes in the red blood-cells. 2. Marked diminution in the number of the blood platelets. 3. No constant variation in the white blood-cells. 4. Normal coagulation time of the blood. 5. A marked increase in the bleeding time. 6. Loss of contractility of the blood clot.

Frank, under the term "*Die essentielle Thrombopenie*," separates this type from the other varieties of purpura and considers it a clinical entity.

Fonio separates the hemorrhagic diatheses (other than hæmophilia) into three groups:

1. The Secondary Purpuras.—These have a known etiology and include the purpuras which occur in the febrile diseases (small-pox, typhus, ulcerative endocarditis, etc.), in peritonitis, in blood diseases (the leukæmias, pernicious anæmia); in diseases of the liver; due to the action of such poisons as phosphorus, benzol, snake venom, etc.; in scurvy, *melena neonatorum*, etc.

2. The Anaphylactoid Purpuras.—The etiology is unknown and the hemorrhagic diathesis is merely a part of the reactive symptom complex of some anaphylactic agent.

In this group the attacks recur at varying intervals with a free interval in between the attacks. The symptoms are various, fever, joint pains and swelling, urticaria, erythema, œdema, polyneuritis, albuminuria, hemorrhagic nephritis, colic, melena, etc. The occurrence of the various symptoms, the petechial eruptions, ecchymosis, etc., overlap and blend in the different forms and may exhibit their most marked symptoms in varying areas.

The blood platelets are slightly increased or very slightly below normal in

* Read before the American Surgical Association, June 2, 1923.

number, the clotting time and the bleeding time are normal, and the blood clot contracts normally.

3. Idiopathic Purpura.—In this group he places those various forms of the hemorrhagic diatheses which are primary. The etiology is unknown. Without warning bleeding into the skin, from the mucous membranes, melena,

	Anaphylactic purpura.	Idiopathic purpura.
Etiology.	Known or suspected causative agent. Primary fever. Premonitory symptoms.	Unknown. No fever. No premonitory symptoms.
Premonitory symptoms.	Primary fever, urticaria, œdema, joint pains, hemorrhagic nephritis, colic, melena, etc.	None.
Bleeding time.	Normal.	Lengthened.
Clotting time.	Normal.	Normal.
Retraction of clot.	Normal.	Absent or markedly diminished.
Blood platelets.	Increased or slightly decreased.	Markedly decreased. May be absent during attack.
	Hæmophilia.	Idiopathic purpura.
Etiology.	Unknown.	Unknown.
History.	Classical history of bleeders in family involving males transmitted through female line.	No typical history. May have history of similar condition in the family but no definiteness in the transmission.
Cause of bleeding.	Traumatic.	Usually spontaneous, frequently multiple. Periodic with free interval. Trauma may cause bleeding but is not so definite as in hæmophilia.
Bleeding time.	Markedly lengthened.	Lengthened. Increased (especially during attacks).
Clotting time.	Markedly lengthened.	Normal.
Blood platelets.	Normal or increased in number.	Markedly decreased or absent during attacks.

hæmatemesis, nose bleed and hæmaturia occur. Fever is absent unless the case is otherwise complicated.

The characteristic features are, increased (lengthened) bleeding time, the absence of retraction of the blood clot or great diminution of this con-

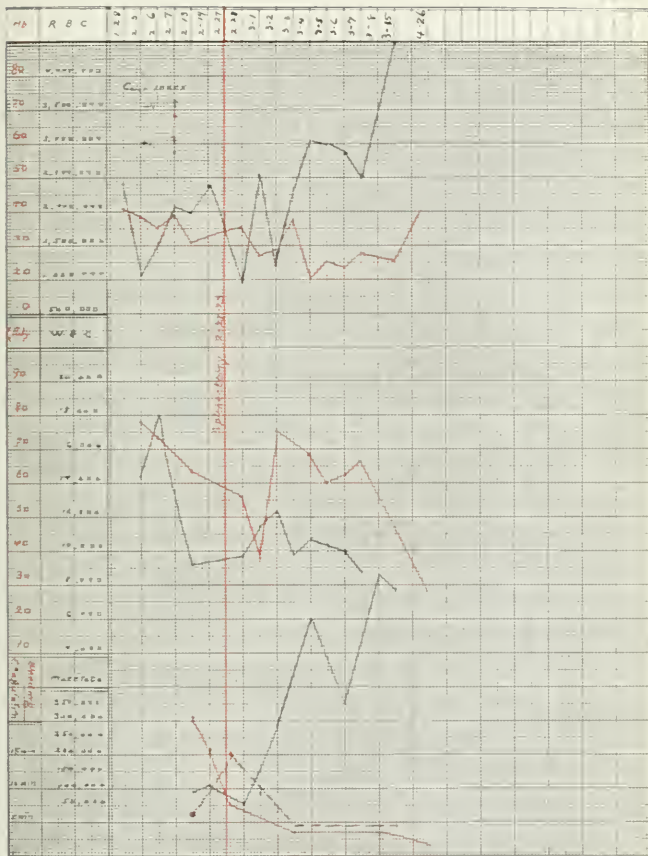


FIG. 1 — Platelets. — — Bleeding time.

traction, marked diminution in the number of the blood platelets while the clotting time of the blood is normal.

Fonio gives the schematic forms for the differential diagnosis between anaphylactic purpura and idiopathic purpura, and hæmophilia and idiopathic purpura in the above table.

Kaznelson was struck by the observation of Frank, that in the conditions to which Frank had given the name "essentielle thrombopenie" there was a constant enlargement of the spleen, and formulated the hypothesis that the disease was due to some destructive agent which destroyed the blood platelets and that the spleen, because of its enlargement had some definite relationship to the process of platelet destruction. Acting on this hypothesis in October, 1916, he submitted a female patient of thirty-six who had had the characteristic features of the essential purpura, described by Hayem, Frank, and others, to splenectomy with remarkable results. The blood platelets which were 300 to 600 before operation rose rapidly to 600,000 on the second day after operation. The clot contracted early and the bleeding time diminished, nose bleed stopped and the menses became normal in character. He has had the patient under observation for three years and the improvement has been constant.

Since then Kaznelson has reported two other cases submitted to splenectomy with a satisfactory outcome. Schmidt, Minkowski, Ehrenberg, Keisman, Beneke, Cori have reported other similar cases in the German literature. In America, Bowen reports a satisfactory case from the Buffalo General Hospital and Brill showed two cases at the meeting of the Medical Section of the New York Academy of Medicine on February 15, 1923, submitted to splenectomy with a satisfactory outcome.

Case Report.—Esther C., eight years old, was admitted to the First Medical Division, Doctor Connor's service, on January 27, 1923 and discharged March 16, 1923.

Her present illness began two days before admission with almost constant bleeding from the nose and gums, and the appearance of red spots on the body. She has not vomited blood or passed blood in urine or stools.

Past History.—Patient was well up to three years ago, then had scarlet fever; she recovered and was well up to one year ago. At that time she began to have repeated nose bleeds which were difficult to stop, at intervals of every two or three weeks. One week ago she had a bronchopneumonia from which she is now convalescing.

Family History negative for family bleeding, two brothers and sister well.

Examination showed well nourished, pale child, with hemorrhagic spots on face. Bleeding from left nostril and gums. Heart, lungs, abdomen were negative. Examination of skin showed hemorrhagic areas over the entire body most marked over the lower extremities. In one area on the hip there was a large ecchymotic area resembling a bruise.

Clinical pathological report:

Red cells, 2,400,000—H. B. 40%, Color index 0.8.

White cells, 38,000—Polymorphonuclears 85%, Lymphocytes 11%, Large mononuclears 4%.

Platelets, 40,500.

Coagulation time 6 minutes.

Bleeding time more than 20 minutes.

Clot did not contract.

Fragility test—Hemolysis began at 0.45, complete at 0.36.

Temperature 99, Pulse 116, Respiration 26.

Chronological Course:

Day of admission 15 c.c. whole blood intramuscularly.

15 c.c. horse serum intramuscularly.

First day after admission.

Second day after admission.

Third day after admission.

Fourth day after admission.

Fifth day after admission.

Sixth day after admission.

Seventh day after admission.

Eighth day after admission.

Ninth day after admission.

Tenth day after admission.

Eleventh day after admission.

Twelfth day after admission.

Fifteenth day after admission.

Sixteenth day after admission.

Seventeenth day after admission.

Eighteenth day after admission.

Nineteenth day after admission.

Twentieth day after admission.

Twenty-first day after admission.

to

Twenty-ninth day after admission.

Thirtieth day after admission.

Vomited blood.

Nose bleed for three hours, packing.

Nose bleed, slight, packing.

Transfusion 150 c.c. of blood intravenous (Unger method) followed by chill.

No bleeding since transfusion.

Bleeding from right nostril, packed.

Nose bleed, practically throughout day, partially stopped by packing. 15 c.c. horse serum intramuscularly.

Enema, large stool containing altered blood.

Nose bleed, hematemeses, transfusion 340 c.c. blood, followed by chill.

No bleeding.

Melena, nose bleeds.

Nose bleed not stopped by packing, cocaine, adrenalin, monochloracetic acid.

Stopped with thromboplastin.

No bleeding, palpable spleen noted.

} Nose bleed slight.

Transfusion 250 c.c. followed by chill. Severe hemorrhage from left nostril for five hours, vomited two pus basins of blood.

Nose bleed all afternoon. Not controlled by packing.

Melena, vomited blood during day. Constant oozing from nostrils not stopped by thromboplastin.

} No bleeding.

Profuse nose bleed, chills, much worse. Consultation with Dr. R. G. Stillman.

On February 27th, thirty-one days after her admission, at the suggestion of Dr. R. G. Stillman, of the First Medical Division, splenectomy was done through a left rectus incision and a somewhat enlarged spleen easily removed. No

hæmolymp-nodes were noted along the splenic vein. The liver and gall-bladder seemed normal. The blood was quite watery. Tier closure of the abdomen without drainage. The wound healed by primary union and the patient was sent to the country on the seventeenth post-operative day.

The essential features of the case following the splenectomy were the immediate cessation of the bleeding, the marked increase in the number of blood platelets from 50,000 to over 600,000, the change in the bleeding time from 15 to less than 5 minutes and the marked improvement in the condition of the child. This improvement has continued up to the last observation made on May 25, 1923.

The last observations on the blood made by Dr. Ralph G. Stillman on April 26, 1923 are as follows:

Bleeding time $2\frac{1}{2}$ minutes. Hæmoglobin, 40%

Polymorphonuclears, 24.0%

Lymphocytes, 68.8%

L.M. and Tr., 4.0%

Eosinophiles, 2.4%

Normoblasts one to each 250 white cells.

Film shows leukocytosis, well marked pallor of red blood-cells. Some granular basophilia and slight polychromatophilia. There are abundant platelets, looks like a secondary anemia.

Pathological Report.—Esther C., May 16, 1923. Hyperplasia of the pulp. Myeloidization. Specimen consists of a spleen of normal contour, rather dark bluish-red color. Capsule elastic, not very tense. Weight with contained blood 120 grams. (Patient's weight 47.5 lbs. 21-590 kg.) Size 4 mm. x 5.5 x 11 mm. On section of capsule much blood escaped estimated at about 15 c.c. Piece removed sterile for culture. Sections placed in formalin, bichloride, Zenker and absolute alcohol. On section the cut surface is smooth, bright red and very thickly studded with follicles that appear of normal size. The consistence is firm, possibly slightly firmer than normal. There was no obvious increase in connective tissue. No hemorrhages were seen. Films made from surface.

Stained film shows the usual number of lymphocytes and large mononuclear cells. Polymorphonuclear leukocytes, neutrophils are moderate. Eosinophilic leukocytes are fairly numerous. There are many normoblasts and a few megaloblasts. There are also a moderate number of myelocytes. Most of them neutrophilic but a few eosinophilic and basophilic. From the cells found in these films one would expect to find in the spleen areas of myeloidization and possibly also of erythropoiesis.

On microscopic examination there appears to be no increase in the amount of fibrous tissue present. Lymphoid follicles all have large germinal centres, but are no larger than one would expect in the spleen in a child of this age. The arteries in the follicles show almost uniformly a thickening and hyalin degeneration of the wall and a narrowing of the lumen. The venous sinuses appear to be approximately normal in size. The pulp in places shows an increased blood content and a hyperplasia of the pulp cords. There are seen in the pulp occasional nucleated red cells and a moderate number of myelocytes. There are also a number of undifferentiated mononuclear cells whose exact nature is unknown. There appears to be a slight increase in the number of eosinophiles present. Collections of blood platelets were not recognized.

Bacteriological Report.—Doctor Wheeler. Cultures from the spleen were sterile.

CONCLUSION

The removal of the spleen has a definite effect in the idiopathic type of hemorrhagic purpura and this effect seems to be related in some way to the change in the bleeding time and in the number of the blood platelets.

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SPECIAL POINTS IN GALL-BLADDER SURGERY*

BY GEORGE W. CRILE, M.D.

OF CLEVELAND, OHIO

THE outstanding problems of gall-bladder surgery remain practically unchanged with the passing years. In this paper, therefore, I shall confine myself to a discussion of certain present opinions which are based upon the experience of my associates and myself in 1235 operations on the gall-bladder among which the records of 886 operations are available for detailed study.

Diagnosis.—As in the diagnosis of hyperthyroidism, of cancer of the stomach, of nephrolithiasis, of appendicitis, it is not the frank, typical case which challenges us, but the case with vague, disquieting, sometimes acute, often chronic symptoms which, while perhaps they simulate most closely those of a cholelithiasis or cholecystitis, may refer to the stomach, the kidneys, the appendix, or the pancreas. In some cases stones may be promptly and clearly defined by a röntgenogram, or the outline of a thickened enlarged gall-bladder may be visible. In others the diagnosis as far as the röntgenogram is concerned is based upon the presence of abnormalities in adjacent organs and in many cases series of plates are required. It has been our experience that our percentage of correct pre-operative diagnoses increases in direct relation to the amount of study which is devoted to the case by our röntgenologist.

As to the diagnostic value of the Lyon test, we agree with Fitz † of the Mayo Clinic that "it seems doubtful whether much diagnostic significance can be attached in the clinical study of cases to similar analyses of bile, the specimens of which are collected through the duodenal tube by Lyon's method, and at best by an indirect route from an undetermined source in the biliary tract."

Whatever diagnostic aids are utilized, however, and in uncertain cases these should include all the measures at our command, it should be emphasized that, as in the differential diagnosis of hyperthyroidism, or of appendicitis, final dependence must be placed upon clinical judgment.

In certain cases, however, despite the most complete history, despite a painstaking physical examination, despite the aid of the röntgenologist, despite chemical analyses, and even despite a direct examination through a right rectus incision, the correct interpretation is not made. The one final criterion, therefore, is the end-result.

Management.—The management of cases of gall-bladder disease, which includes the type of operation, is strictly individualized.

In general we have followed the lead of the Mayo Clinic as to cholecys-

* Read before the American Surgical Association, June 1, 1923.

† Fitz and Aldrich: Clinical Observations on Certain Constituents of the Bile. J. A. M. A., vol. lxxix, p. 2199, Dec., 1922.

ectomy, and it has been our experience that this method yields the higher percentage of post-operative symptom-free results; our changing opinion regarding the relative values of cholecystectomy and cholecystostomy is indicated by the fact that although our total statistics show that 43 per cent. of our series were cholecystectomies and 57 per cent. cholecystostomies, during the years 1917 to 1922 inclusive, this relation was reversed, 84 per cent. of the later series being cholecystectomies as opposed to 16 per cent. cholecystostomies.

Nevertheless in a certain group of cases, cholecystostomy bears a lesser mortality. Therefore, in patients with high blood-pressure and interstitial nephritis, in the aged and in obese patients, and in severely jaundiced patients, the lesser operation is performed.

In emaciated, jaundiced, depressed cases, a slow intermittent decompression by means of a fluid-tight drainage system is important. This manœuvre is comparable to that employed by urologists in cases in which the urinary bladder is distended.

In a jaundiced case in which the gall-bladder is a shrunken mass of scar tissue containing no bile, while the common duct is dilated, decompression is accomplished by drawing off most of the bile with a syringe, opening the duct to remove any stones which may be present in the immediate field, and establishing a fluid rubber tube drainage, with an abundance of gauze drainage just below the point of common duct drainage.

The point of prime importance in the case of a greatly depressed patient is the performance of the minimum amount of surgical trauma needed to establish drainage.

After the utmost possible degree of restoration has been accomplished by blood transfusion, hypodermoclysis, hot packs, rest, the further operative procedures may be performed with lessened danger. It should be borne in mind that morphine is contraindicated in these cases because of its specific depressing effect upon the liver.

In all operations upon the gall-bladder the control of infection is of paramount importance, of more importance, even, than in the case of operations within the pelvic cavity or in the lower abdomen, for within the upper abdomen the defense against infection is weaker than in the lower abdomen. Surprisingly active infection, therefore, may follow very slight soiling by the infected contents of the gall-bladder or ducts.

The best measures of prevention are an ample exposure and an adequate preliminary packing with gauze so complete that not a pad will be changed during the operation. Even when every possible precaution has been taken we occasionally encounter a leakage of bile. For this reason I still hesitate to close without drainage. In our experience a high Bevan incision serves best both for an ample exposure and for the post-operative restoration of a sound abdominal wall. In cases in which the condition of the patient demands the minimum primary operation, *i.e.*, the establishment of drainage and no more, a very short incision immediately over the gall-bladder and the insertion

SPECIAL POINTS IN GALL-BLADDER SURGERY

of the drainage tube constitute almost a minor operation. In every case it is important to exercise the utmost care to prevent the slightest tear or cut into the liver substance. In an occasional case of prolonged severe jaundice associated with infection, a fatal hemorrhage may occur in spite of calcium and repeated blood transfusions. In one such case six donors were used, giving a total of 3800 c.c. of blood, and calcium was used before and after operation without avail.

Statistics.—It is difficult or impossible in this as in other fields satisfactorily to compare the statistics of many reporters because of the variations in the form of their presentation. The following figures culled from the literature, however, are of especial interest in their bearing upon the cholecystectomy *vs.* cholecystostomy controversy.

Operative mortality			End results					
	Cholecystectomy	Cholecystostomy	Cholecystectomy			Cholecystostomy		
			Cured	Imp.	Not imp.	Cured	Imp.	Not imp.
Erdman, 1910. . . .	4.0%	4.2%						
Truesdale, 1921 . . .	2.3		89%	6%	5%	55%	32%	13%
(Exclusive of carc.)								
Goodwin, 1921. . . .	3.3%	5.0%	88%	9%	3%	71.5%	23%	5.2%
Homans, 1920. . . .	5.3%		77%	19.4%	3.6%			
			(Good)	(Fair)	(Bad)	(Good)	(Fair)	(Bad)
Moore, 1921	5%	5%	70	20	10	40	45	15
Mayo, C. H., 1920.	Operative mortality, not divided as to type of case—2.2 to 2.4%		(Results not divided as to type of operation)					
			Cure 60%		Great imp. 30%		Less imp. 10%	

In our own series among a total of 1235 operations upon the gall-bladder and gall-ducts, the mortality rate has been: cholecystectomy, 2.5 per cent.; cholecystostomy, 5.4 per cent.

Although these figures make it appear that cholecystectomy is the safer operation, this is due to the fact that cholecystostomy is used in the "bad risk" cases.

SUMMARY

The points of prime importance in the surgical management of gall-bladder diseases may be briefly stated as follows:

1. Strict individualization of patient.
2. Restoration and maintenance of the internal respiration of the cells.
3. Decompression only, in extreme cases.
4. Special precautions against infection.
5. Drainage to prevent possibility of post-operative infection from leakage.
6. The criterion for choice between cholecystectomy and cholecystostomy is the condition of the patient.

THE MORTALITY FOLLOWING OPERATIONS ON THE LIVER, PANCREAS, AND BILIARY PASSAGES

A STATISTICAL STUDY

By E. STARR JUDD, M.D.,

AND

JOHN H. LYONS, M.D.

FELLOW IN SURGERY, THE MAYO FOUNDATION
OF ROCHESTER, MINN.

THIS study concerns the mortality following operations at the Mayo Clinic during 1922, for diseases of the gall-bladder and associated viscera. The operations were performed by ten surgeons on the permanent staff of the Clinic in its hospitals. Many of the cases were ordinary uncomplicated disorders of the gall-bladder, while others were much more serious, as the infection had perforated the gall-bladder and invaded other tissues, or the flow of bile had been obstructed, with resultant biliary cirrhosis and complete jaundice. We were gratified to find, in comparison with former years, that the results were better.

Factors Tending to Diminish the Mortality Rate.—It is difficult to decide on the factors that contributed to the better results because there was no control from which to make comparative studies, but I am inclined to attribute the diminished mortality to several factors, and particularly, to the efficacy of the preparation of many of these patients before operation. It is interesting to note that, although more jaundiced patients have been operated on than in any previous year, the danger of post-operative bleeding has been practically eliminated; this undoubtedly is a factor in lowering the mortality. More accurate observation of the patient immediately following operation, and anticipating some of the serious complications, has, I believe, proved a factor in the better results.

The operative technic is practically the same now as in former years, except that the amount of drainage used in the operative field has been reduced; whereas it was formerly believed to be necessary to use a considerable amount of gauze and rubber tissue and rubber tubes for drainage, it is now considered much safer to reduce the drainage material to a minimum, and in the clean cases in which the technic has been accurately carried out it is better to close the abdominal wound without drainage. Drainage has not been dispensed with in cases in the Clinic in which it was necessary to open the common duct.

Experience and better judgment may be regarded as factors which tended to attain the results of 1922. In Table I we have tabulated the causes of death of eleven patients operated on. This is interesting because it shows the proportion of patients who present themselves too late for any form of treatment, and also approximates the proportions of patients with primary

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cancer of the pancreas for which very little can be done. These patients were all moribund or nearly so on admittance, and surgical treatment could not avail.

TABLE I.
PRINCIPAL CAUSES OF DEATH OF PATIENTS NOT OPERATED ON.

Suppurative cholecystitis	1
Choledocholithiasis	1
Cirrhosis of the liver	1
Carcinoma of the gall-bladder	1
Carcinoma of the liver	1
Carcinoma of the pancreas	6

OPERATIONS ON THE LIVER

In Table II is a list of the twenty-two cases in which an operation for primary disease of the liver was performed. The largest single group of cases proved to be cancers of the liver. Undoubtedly most of these cancers were secondary, but the explorations seemed to be legitimate, and the clinical

TABLE II.
MORTALITY FOLLOWING OPERATIONS ON THE LIVER.

	Cases	Deaths	Cause of death
Abscess: Drainage	2		
Carcinoma: Exploration (excision of specimen)	8	1	Pneumonia; necropsy refused.
Cirrhosis: Talma-Morrison operation	1		
Exploration	5		
Cyst: Drainage	2		
Excision	2		
Prolapse: Hepatopexy	1		
Infectious hepatitis with jaundice: Cholecystostomy	1		

histories and physical examinations indicated a reasonable prospect for improvement following operation. Had the condition been known before operation, exploration would not have been made, but it seems impossible to establish the inoperability of certain cases without exploration. One patient died after exploration which revealed an extensive cancer of the liver; this

is a demonstration of the serious risk attending this type of operation. Necropsy was not obtained in this case and the death is ascribed to possible pneumonia.

There were six cases of cirrhosis of the liver, but in only one did the Talma-Morrison operation appear to be suitable. In the presence of jaundice and a large amount of ascites the Talma-Morrison operation has not been very satisfactory, while in cases in which there is no jaundice and the quantity of ascites is not too great, or the liver too badly diseased, this plan of transferring the circulation has seemed to accomplish a great deal.

OPERATIONS FOR UNUSUAL CONDITIONS OF THE GALL-BLADDER

In Table III are listed cases of unusual disorders of the gall-bladder and ducts. There was one case of acute perforation of the gall-bladder, and also

TABLE III.
MORTALITY FOLLOWING OPERATIONS FOR UNUSUAL CONDITIONS OF THE GALL-BLADDER AND DUCTS.

	Operations	Deaths	Cause of death
Acute perforation of cystic duct.....	1		
Acute perforation of gall-bladder: Cholecystostomy.....	1		
Carcinoma of ampulla of Vater: Choledochostomy.....	1		
Resection of ampulla: Cholecystostomy, choledochoduodenos- tomy	1	1	Hemorrhage and hepatic insufficiency.
Carcinoma: Exploration.....	7		
Cholecystectomy.....	2	1	Peritonitis; necropsy refused.

one in which a perforation occurred in the cystic duct. Operation was performed early with recovery in both cases. Acute perforation of the gall-bladder, or of the bile ducts, with the pouring of bile or stones and pus into the general abdominal cavity has occurred very rarely. On the other hand, cases are often seen in which there has been a small perforation with a slight amount of leakage and a local abscess well walled off, and quite often cases have been encountered in which a perforation has extended into the duodenum, stomach, or colon. Some years ago I reported a case of perforation of the common duct and a large amount of bile free in the abdomen; no similar case has since been observed in the Clinic. Acute perforation of the gall-bladder occurs, as a rule, in only one of several hundred cases of cholecystitis.

In the series of cases of diseases of the gall-bladder and ducts were two of carcinoma of the ampulla of Vater.

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In one case a man, aged seventy years, had been operated on elsewhere three years before for cholecystitis, and the gall-bladder had been removed. He said that he was jaundiced when he was operated on. He recovered very quickly, the jaundice soon disappeared, and he remained well until three months before presenting himself at the Clinic for examination. His chief and only complaint at that time was a painless jaundice with slight loss of weight and strength. The jaundice had appeared three months before and had persisted but fluctuated in intensity. At operation the liver revealed definite biliary cirrhosis and the common duct was greatly dilated; the pancreas seemed normal, but the neoplasm could be readily made out in the ampulla. The common duct was opened with a small incision, and a rather thin colorless fluid, which was under tension, escaped. Without allowing all of this fluid to escape at once with the possibility of sudden production of a negative pressure in the ducts of the liver, a small tube was stitched into the opening in the duct, and by keeping the tube closed by a clamp part of the time, the liver was gradually decompressed. Whether or not this was of any avail, is doubtful, but there was no reaction following the procedure. Drainage from the tube became bile-stained in a few hours, and normal-looking bile appeared in a short time. The patient recovered completely. Because of his age and the fact that he was quite contented with the tube and opposed to further operating, he was dismissed with the tube draining his common duct. He has remained well thus far, seven months after the operation.

In the second case of cancer of the ampulla, the patient was a man aged fifty-five years, who was in extremely bad condition because of deep jaundice which had existed for several months. After careful preparation by calcium given intravenously, an exploration was made under local anaesthesia and revealed extensive biliary cirrhosis with gall-bladder and ducts greatly distended. When the gall-bladder and ducts were emptied, the neoplasm could be palpated at the ampulla. It seemed best to establish biliary drainage by inserting a tube into the gall-bladder and waiting for a return of normal activity of the liver with improvement in the general condition before resecting the ampulla. Bile drained rather freely. At the end of three months, resection of the ampulla was performed without the usual preparation. It was found that some interference still existed with the biliary flow and that the biliary cirrhosis still persisted. A resection was made, but the patient died from insufficiency of the liver and hemorrhage from all surfaces. If it could have been recognized before the second operation, that there was still some biliary cirrhosis in spite of the fact that there was no apparent jaundice, by preparing the patient in the usual manner, I believe the result obtained might have been different.

Cancer of the gall-bladder was found in nine cases. In seven, it was too extensive for radical removal. In two cases the gall-bladder was removed; one of the patients died. If this case had been recognized as cancer before beginning the cholecystectomy, removal would not have been attempted.

There was a history of colic lasting twenty-one years. A chronic infection was believed to be present until the operation had been carried too far to be stopped. Part of the duodenum had to be resected and a very extensive operation carried out. Death occurred on the fourth day, probably from peritonitis. When carcinoma occurs in the gall-bladder, it is usually in cases in which gall-stones have existed for a long time. Not many radical operations for this condition have resulted in cure.

In Table IV are tabulated the results of operations for cholecystitis. Forty-five cholecystectomies were performed for acute cholecystitis with no deaths, and twenty-two cholecystostomies with one death. The grading of acute or

TABLE IV.
MORTALITY FOLLOWING OPERATIONS FOR CHOLECYSTITIS.

	Operations	Deaths	Cause of death
Cholecystitis, acute, with or without stones			
Cholecystectomy.....	45		
Cholecystostomy.....	22	1	Hepatic insufficiency
Cholecystitis, chronic, with or without stones.....			Peritonitis, 5; pneumonia, 3; dilatation of stomach, 1.
Cholecystectomy.....	890	11	Pulmonary embolism 2.
Cholecystostomy and partial cholecystectomy.....	1		
Cholecystostomy.....	45	2	Peritonitis. Liver insufficiency, 1.
Exploration.....	1		
Exploratory choledochotomy.....	31		
Cholecystitis, chronic, with stones in the gall-bladder and common duct: Cholecystocholedochotomy.....	1		
Cholecystitis, chronic, with stones and biliary fistula: Cholecystectomy; dissection of the fistulous tract.....	2	1	Peritonitis, empyema.
Cholecystostomy.....	1		
Cholecystitis, chronic, with stones; retroversion of the uterus; appendicitis: Cholecystectomy; intraperitoneal shortening round ligaments, appendectomy.....	1	1	Pulmonary oedema.
Cholecystitis, chronic, with stones, duodenal ulcer and chronic appendicitis: Cholecystectomy, posterior gastroenterostomy, appendectomy.....	10	1	Peritonitis.
Cholecystitis, chronic, with stones, post-operative ventral hernia: Cholecystectomy; herniotomy.....	12	1	Peritonitis; fat embolism.

chronic inflammation in the gall-bladder, was made by the pathologist as he examined the tissue: The one death followed a drainage operation. The patient had been very sick for many weeks with an infected gall-bladder without signs of jaundice. It seemed best to operate as little as possible, and to

establish drainage, with the idea of removing the gall-bladder and examining the ducts at another time if there was further trouble. Free drainage followed the opening of the gall-bladder and removal of stones, but without reaction, and death occurred on the fifty-second day. Necropsy revealed infection of the liver and a stone in the common duct. We had suspected the presence of a stone, but the patient's condition did not warrant exploration. It has been our experience often that when such patients do not improve, a common duct stone may be present even though there is no evidence of jaundice.

There were eleven deaths in 890 cholecystectomies for chronic inflammation in the gall-bladder. Five of the patients died from peritonitis; one of these did not come to necropsy. One patient with a serious cardiac disorder died a cardiac death. Three died from pneumonia. Dilatation of the stomach was recorded in one case, since nothing else could be found to account for the death. However, this condition existed at the time of the operation. Two of the patients died from pulmonary embolism. Many of the patients were obese. In some instances their weight had been reduced before the operation. It is questionable whether an obese patient is any better, or as good a surgical risk after a sudden loss of weight, as he is normally. It would seem that there should be no deaths following operations for chronic disease of the gall-bladder, yet it is very unlikely that we shall ever be able to operate in a very large series of these cases without some serious consequences.

ABSTRACT OF THIRTEEN CASES IN WHICH OPERATION WAS FATAL

CASE I.—R., a man aged forty-five years, an alcoholic, had had subacute cholecystitis with stones and hydrops. Operation under nitrous oxide and ether was performed and the gall-bladder was found to be buried in the liver. Two gauze strips and one tube were inserted because of oozing after the gall-bladder had been removed. These drains were removed the third and the fourth day, respectively, resulting in bile drainage. Evidence of toxæmia was manifested soon after operation. Death occurred on the eleventh day from peritonitis.

CASE II.—M. P., a woman aged fifty-three years, was in good general condition. Cholecystitis with stones, and pancreatitis were found. Cholecystectomy and appendectomy were performed. On the third day there was vomiting and the pulse became irregular. Death from peritonitis resulted on the seventh day. There was a subphrenic abscess, but no bile in the abdomen. The wound was closed without a drain.

CASE III.—R. S., a man aged thirty-nine years, came to the Clinic in fair general condition. He had lost twenty-six pounds in weight, and his blood-pressure was low. At operation appendicitis and slight cholecystitis were revealed. The gall-bladder and appendix were removed. The abdomen was closed without drainage. The patient died the fourth day. Necropsy revealed early peritonitis, 300 c.c. of blood, and bronchopneumonia, but no bile in the abdomen.

CASE IV.—J. P., a man, aged twenty-eight years, was in good general condition. His blood-pressure was low. The history and findings were indefinite. A cholecystectomy was performed under difficulties. Chronic inflammation in the gall-bladder and adhesions were found, but no stones were present. A drain was not inserted. Death occurred on the fourth day from peritonitis.

CASE V.—M. U., a woman, aged sixty-seven years, was very obese. She had fatty myocarditis and much pain and infection. Cholecystostomy was attempted

without success, and the gall-bladder had to be removed. There was a temporary cardiac reaction. The patient died the tenth day. Necropsy revealed peritonitis and marked arteriosclerosis. There were no clinical signs of peritonitis and the patient died a cardiac death.

CASE VI.—T. S., a man, aged fifty-four years, weighed 210 pounds. Before operation his weight was reduced eighteen pounds. It was difficult to expose the gall-bladder which was much infected and contained many stones; the gall-bladder was removed with only a slight amount of soiling. The wound was closed without a drain. Influenza developed within a few hours after operation and death ensued in less than forty-eight hours. Necropsy was not performed.

CASE VII.—F. A., a man, aged sixty-one years, had had arteriosclerosis and emphysema. His heart sounds were not clear. He had suffered from abdominal attacks and had been unable to care for himself. The operation revealed much infection in the gall-bladder and appendix, both of which were removed. Two strips of gauze and one tube were used as a drain. The patient did well for forty-eight hours, then showed all signs of pneumonia, and died on the sixth day.

CASE VIII.—B. DeJ., a man, aged thirty-nine years, had been in good general condition, but had lost twenty-two pounds in a few months. The appendix, and the gall-bladder which contained stones, were removed. A tube and gauze drain was used. Coughing and signs of pneumonia developed on the third day; on the tenth day the wound opened and had to be resutured. No signs of peritonitis resulted, but the pneumonia progressed, and the patient died on the twenty-second day.

CASE IX.—R. H. J., a woman, aged twenty-seven years, came to the Clinic with symptoms simulating subacute perforation. At operation many adhesions were found around the gall-bladder, but no ulcer. The gall-bladder was removed and one tube drain inserted. The patient died on the third day, seemingly of respiratory failure. Necropsy revealed splanchnoptosis with general hypoplasia, œdema of the liver, and cloudy swelling of the kidneys.

CASE X.—P. G., a woman, aged fifty-six years, had been in fair general condition except for severe gall-bladder attacks, and marked varicosity of the veins in the right leg. Empyema of the gall-bladder was revealed at operation. The gall-bladder and appendix were removed, and a gauze and rubber drain was used. There was some tachycardia on the third and fourth days after operation. The patient was up on the eleventh day, but died while sitting up on the twelfth day. The wound had healed. Necropsy revealed pulmonary embolism.

CASE XI.—F. W. M., a woman, aged forty-nine years, had been in fair general condition. Dilatation and curettement were performed, a specimen was removed, and the cervix repaired. The gall-bladder, which contained no stones, and the appendix were removed. Recovery was uneventful. The wound healed, but sudden cyanosis and death occurred after the patient had been up. Necropsy was not performed.

Removal of the gall-bladder has been the operation of choice, but for special reasons drainage operations were performed on forty-five patients, two of whom died.

CASE XII.—S. P., a man aged fifty-six years, in good general condition, had had colics for one year. The gall-bladder was empyematous and difficult to remove. One dressed tube and gauze were inserted, and the gall-bladder was drained. The patient became jaundiced and died on the sixth day, probably from peritonitis. Necropsy was not performed.

CASE XIII.—W. R. H., a man aged sixty-two years, had a splenectomy for Banti's disease six weeks before, when gall-stones and advanced portal cirrhosis

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were discovered. The gall-stones were removed and the gall-bladder was drained. The patient died on the seventh day, probably from portal cirrhosis. There was some thrombosis of the splenic vein.

The last three deaths referred to in Table IV show the seriousness of too much operating at one time. It cannot be said that the result would have been better if the cases had been handled differently, but as a rule it is probably more advisable to operate in two stages than do too much at one time. This applies especially when more than one incision is necessary; usually it is not best to operate in the pelvis and in the upper abdomen at the same time.

TABLE V.

MORTALITY FOLLOWING OPERATION ON THE GALL-BLADDER AND ON COMMON DUCT.

	Operations	Deaths	Cause of death
Stones in the gall-bladder or bile ducts.			Liver insufficiency, 1.
Cholecholestomy.	25	2	Peritonitis, 1.
Cholecholestomy and cholecystectomy. . .	66	1	Liver insufficiency.
Cholecholestomy and cholecystostomy	23	1	Pneumonia.
Cholangitis with choledocholithiasis: Choledocholithotomy.	1		
Cholangitis: Cholecholestomy.	4		
Diverticulum cystic duct: Excision.	2		
Fistula, cholecystoduodenal: Closure.	5		
Fistula or stricture common duct: Cholecystoduodenostomy.	1		
Cholecholestomy.	1	1	Liver insufficiency.
Drainage fistula.	1		
Excision fistulous tract.	2		
Hepatico-duodenostomy or reconstruc- tion of common duct.	12 143	3 8	Shock, 1; hemorrhage, 1; hepatic insuffi- ciency, 1.

In Table V are listed operations on the common duct. Besides these the common duct was explored in thirty-one cases in which the gall-bladder was removed. The exploration was made because the duct was greatly enlarged, or because a stone was suspected, or could not be ruled out. It is interesting to note that of the four deaths in 150 operations on the common duct (Tables IV and V), not one resulted from hemorrhage, in spite of the fact that many of the patients were deeply jaundiced at the time of operation. All of these jaundiced patients were given careful preparatory treatment, as outlined by Walters,¹ and undoubtedly this is the reason many of them did not bleed.

¹ Walters, W. W.: Pre-operative Preparation of Patients With Obstructive Jaundice. Surg., Gynec. and Obst., 1921, vol. xxxiii, pp. 651-656.

ABSTRACT OF FOUR CASES IN WHICH OPERATION WAS FATAL

CASE XIV.—G. B. B., a woman, aged sixty-one years, had been operated on twice before, once for drainage of the gall-bladder and later for removal of it. She had had disease of the gall-bladder for forty-five years, and had lost forty pounds. She had had fluctuating jaundice, which was sometimes very deep, but was clearing up at the time of examination. Her blood coagulation time was three minutes. At operation stones were removed from the thick, infected duct. Drainage of bile gradually decreased. Convalescence was good for five days, then all the symptoms of insufficiency of the liver developed. Necropsy revealed atrophy of the liver and kidneys.

CASE XV.—J. W. K., a man, aged sixty-three years, had had his gall-bladder removed two years before, with relief for six months. Since then he had had attacks of distress and jaundice. At operation a stone was removed from the common duct. No suture was required to close the duct, and a Penrose drain was inserted down to the opening. There was no jaundice at the time of the operation. The patient died of peritonitis on the fourth day. There was considerable bile in the peritoneum.

CASE XVI.—C. W., a woman, aged sixty-three years, had been operated on at the Clinic ten years before, for stones in the common duct and gall-bladder. The stones had been removed and drainage instituted. The patient had been well for a few years and then similar attacks had recurred. The duct was dilated, but no stone was found in it; one may have been pushed through. A cholecystectomy and choledochostomy were performed; bile drained freely. Two Penrose drains were inserted. The patient left the hospital on the eighteenth day, but did not gain afterwards, and died on the twenty-eighth day from asthenia and hepatic insufficiency. Necropsy was refused.

CASE XVII.—T. D., a man, aged sixty-three years, had had attacks of pain with jaundice, and had lost twenty pounds. He had jaundice 3, and low blood-pressure at the time of examination, and his blood coagulation time was seven minutes. He was prepared with calcium. At operation the gall-bladder and duct were drained, and a stone removed from the hepatic duct and much bile escaped. The patient died of pneumonia on the eighth day. There was a calculus in the duct, but apparently was not a factor in death as the patient had had a definite pneumonia for several days.

HEPATICODUODENOSTOMIES WITH RECONSTRUCTION OF THE COMMON DUCT

Following twelve hepaticoduodenostomies with reconstruction of the common duct, there were three deaths, one due to shock, one to hemorrhage, and one to hepatic insufficiency. Operations of this type are extremely difficult and often must be performed on deeply jaundiced and otherwise incapacitated patients. A few cases of "liver-shock" have been observed. Possibly because of the sudden release of pressure in the common duct, the reaction in the liver may result in shock. One of the deaths from this condition occurred a few hours after a not unusually difficult operation in which very little blood was lost, and not enough trauma produced to cause shock.

ABSTRACT OF THREE CASES IN WHICH OPERATION WAS FATAL

CASE XVIII.—C. Z. W., a woman, aged forty years, had had her gall-bladder removed elsewhere. Since then she had had no pain, but nausea, vomiting, and very deep, but painless jaundice. Operation revealed no common duct. The patient was in a very bad condition, and there was oozing from the wound. There

MORTALITY AFTER LIVER AND PANCREAS OPERATIONS

was no bile in the ducts. The patient was prepared by the use of calcium. She died on the fourth day. Necropsy was not permitted but it seemed to be a case of hepatic insufficiency.

CASE XIX.—G. W., a woman, aged fifty-seven years, had been operated on at home and her gall-bladder had been removed. She came to the Clinic deeply jaundiced, and was in poor condition. Operation then revealed much infection in the old operative field, and drainage only was made. The jaundice cleared completely and the patient was allowed to go home. She returned one year later, greatly emaciated and jaundiced. A very difficult operation for stricture was performed. The bleeding at the time of operation apparently continued; the patient died the same day from insufficiency of the liver and hemorrhage.

CASE XX.—H. U., a man, aged thirty-one years, had been operated on elsewhere four months before for gall-stones, and cholecystectomy had been per-

TABLE VI.
MORTALITY FOLLOWING OPERATIONS FOR OBSTRUCTIVE JAUNDICE.

	Operations	Deaths	Cause of death
Obstructive jaundice:			
Cholecystostomy.....	1	1	
Cholecystoduodenostomy.....	1		
Cholecystogastrostomy.....	1		
Choledochostomy.....	6	1	Pneumonia.
Obstructive jaundice with contracture of hepaticoduodenostomy opening:			
Enlargement hepatico-duodenostomy..	1		
Obstruction of the common duct (post- operative):			
Incision and drainage of abdominal wall.....	1		
Tuberculosis of the hepatic duct with ob- struction:			
Exploration.....	1		

formed; a biliary fistula had existed since six days after the operation. Much loss in weight had resulted (from 15 to 20 pounds). Operation revealed absence of the lower part of the duct. The hepatic duct was anastomosed to the duodenum. Shock was immediately evident after the operation in spite of there being no jaundice and no loss of blood. The patient died in twenty hours. Necropsy revealed no cause for the death.

In Table VI are listed twelve cases of obstructive jaundice. In nine of these, the gall-bladder was anastomosed to the stomach or duodenum, or the common duct or gall-bladder was drained, and nothing further attempted; two of the nine patients died. Those with drainage of the common duct had been operated on several times before, and were completely jaundiced at the time. Drainage of bile was established with difficulty and never was free.

In Table VII is a list of patients operated on during 1922, for pancreatic diseases. Two of the twenty-four died. One of these was operated on for cancer of the pancreas, producing deep jaundice. The gall-bladder was anastomosed to the duodenum; death resulted from pneumonia two weeks later.

TABLE VII.
MORTALITY FOLLOWING OPERATIONS FOR DISORDERS OF THE PANCREAS.

	Operations	Deaths	Cause of death
Carcinoma:			
Cholecystoduodenostomy.....	1	1	Pneumonia.
Exploration (excision specimen).....	8		
Enterostomy.....	1		
Cyst:			
Exploration, drainage.....	6		
Excision.....	1		
Excision, partial, and drainage.....	1		
Fistula, recurring following drainage pancreatic cyst:			
Dilatation sinus tract.....	1		
Pancreatitis, chronic:			
Cholecystostomy.....	1		
Exploration.....	3		
Pancreatitis, acute hemorrhagic:			
Exploration.....	1	1	Acute pancreatitis.

Palliative operations of this kind are often worth while even in cases of fairly extensive malignancy; in others, it is impossible to know before operation that the disease is malignant, and possibility of cure justifies the procedure. Fortunately, we had only one case of acute hemorrhagic pancreatitis. The condition was serious at the time of the operation, and the patient died on the second day. Diffuse, acute pancreatitis is one of the most serious abdominal conditions with which we have to deal.

FURTHER OBSERVATIONS ON THE USE OF THE CAUTERY IN PEPTIC ULCER *

BY DONALD C. BALFOUR, M.D.

OF ROCHESTER, MINN.

FROM THE MAYO CLINIC

IN 1914, I proposed the use of the cautery for the excision of certain types of peptic ulcer. Since then we have employed the cautery in 725 cases of peptic ulcer. This experience has shown us the types of ulcers to which the cautery is most applicable, the contraindications to its use, the most effective way of utilizing it, the risk of the operation, and its end results. It is upon these points that this series of 725 cases will be reviewed.

Gastric ulcers may, for our purpose here, be arbitrarily divided into three groups: (1) those in which the crater is 1 cm. or less in diameter, (2) those between 1 and 2 cm., and (3) those over 2 cm. The cautery was first suggested for the first group, since it was commonly observed that, after knife excision of such small lesions, the remaining opening was out of all proportion in size to the lesion removed, and it seemed that some method might be devised to avoid this disadvantage. Ninety per cent. of all gastric ulcers involve the lesser curvature, and since a large percentage are small, the cautery has a wide applicability.

The method originally proposed for cautery excision of these small ulcers has been followed; that is, reflection of the gastrohepatic omentum exposing the peritoneal aspect of the ulcer, and accurate location of the crater of the ulcer by palpation, the perforation of the centre of the crater by a Pacquelin, or electric cautery, continuing the burning until the crater is completely destroyed, closing the opening by chromic catgut sutures, and following this procedure with a gastro-enterostomy. The opening to be closed is, therefore, not larger than the crater itself, it is closed with ease, and in the entire series of cases there has been no evidence of leakage. The success of the operation is, of course, dependent on the accurate localization of the crater of the ulcer, and it should be emphasized that the crater of the so-called lesser curvature ulcer is seldom on the lesser curvature; it is usually on the posterior wall.

Ulcers with medium-sized craters, that is, between 1 and 2 cm. in diameter, may be malignant without visible evidence. Because of this possibility, the crater should be exposed to view by opening the stomach, and an excision made by the cautery knife, as suggested by Sistrunk. The portion of the stomach containing the ulcer is first mobilized, the gastrohepatic omentum is dissected free, the site of the ulcer encircled and marked by traction forceps, and the crater accurately palpated. At the edge of the crater an incision is made. The crater of the ulcer in its situation on the posterior wall of the stomach is then

* Read before the American Surgical Association, June 1, 1923.

visualized, excised with the cautery knife, the opening closed in an antero-posterior direction, and the suture line covered by the peritoneal flap. The operation is completed by a gastro-enterostomy. When ulcers of this size, between 1 and 2 cm., are near the pyloric end of the stomach and can easily be mobilized, partial gastrectomy is the operation of choice, but if they are distant from the pylorus, our experience thus far has been that local excision by the cautery and a gastro-enterostomy give such excellent results with such a small operative mortality that one hesitates to employ an operation of distinctly greater risk. Cautery excision combined with gastro-enterostomy has been performed in the Clinic in 329 cases of gastric ulcer with an operative mortality of 2.12 per cent., a lower mortality rate than has been associated with any other type of operation performed for gastric ulcer in the Clinic. In one series of 148 consecutive cases, there was no operative mortality. Eighty per cent. of the patients report satisfactory results from the operation. Fourteen per cent. are only slightly improved, 4 per cent. failed to derive any relief, and 1.1 per cent. are known to have developed ulcers subsequently.

Ulcers over 2 cm. in diameter, as shown by MacCarty, should be regarded as malignant or potentially malignant. Partial gastrectomy is unquestionably justified in these cases, gastro-intestinal continuity being reestablished by whatever method best meets the individual case. These large ulcers may, however, be in such a difficult situation that resection is not warranted. For example, large ulcers high on the lesser curvature, while not suitable for resection, may be thoroughly cauterized with little risk. We have dealt with a number of such cases in this manner with surprisingly good results, even when a gastro-enterostomy has not been performed at the same time. In some, excision of the ulcer with the cautery (which may have been only partial) has been combined with jejunostomy, as suggested by Moynihan, and catheter feeding continued until healing has taken place. I believe there is a larger field for this operation than we have realized, and that Moynihan has drawn our attention to a very useful method of dealing with these awkwardly situated ulcers.

In the series of 725 cases of peptic ulcer in which cautery excision was performed there have been 1.1 per cent. of recurrence of ulcers, including gastrojejunal. There is apparently no greater tendency for an ulcer to recur at the point of excision (providing, of course, that the ulcer has been satisfactorily excised) than at any other part of the stomach. The fact that, in 725 cases we have seen no evidence of a tendency for an ulcer to develop at the point of excision would disprove any theory, or fear, that the cautery, of itself, may give rise to ulcer. Mann has demonstrated that, after extensive excision of the gastric wall by the cautery, healing was so perfect that it was impossible to detect where the excision had been made, and we have observed in patients operated on for other conditions at various intervals after such excision, that the same perfect healing has taken place. This small percentage of recurrences of ulcer following local excision and gastro-enterostomy is not

of itself an argument for routine gastrectomy in gastric ulcer. Moreover, if recurrence of ulcer does take place, resection of the pyloric end of the stomach can be performed. The resection can then be regarded as the second stage of an operation, which is often advantageously carried out in two stages, namely, partial gastrectomy.

In a previous paper, I have shown that the relatively high subsequent death rate in patients operated on for gastric ulcer, in comparison with the normal subsequent death rate following operations for duodenal ulcer, was due to gastric cancer. Cancer may, and does develop after any operation for gastric ulcer, from a gastro-enterostomy to partial gastrectomy, but almost all cancers develop in those cases in which the lesion was not removed, and, judging by the early death from cancer following operation, malignancy existed at the time of the operation. In 418 cautery excisions for gastric ulcer, eight patients (1.9 per cent.) have subsequently died of cancer of the stomach, but this group includes those cases of inaccessible ulcer in which it could not be completely excised, and the earlier cases in which we were not familiar with the most effective manner of using the cautery. Furthermore, the incidence of cancer of the stomach in 418 persons of similar age (average forty-five years) in the general population is about 0.3 per cent. Our results indicate, therefore, that when a non-malignant gastric ulcer is satisfactorily excised and gastro-enterostomy performed, the incidence of gastric cancer following the operation is little more than it is in the general population.

The cautery is a useful adjunct in the management of ulcers on the posterior wall of the stomach, particularly when they are adherent to the pancreas. In these cases it is necessary, in order to secure good end-results, to separate the stomach from the pancreas; the edges of the opening are then excised with the cautery, and the area on the pancreas thoroughly seared.

Duodenal Ulcer.—In cases of duodenal ulcer we have not the same indications for excision, for while the excision of gastric ulcers is imperative, the excision of duodenal ulcers is not, because of the liability to cancer degeneration in the former and the absence of it in the latter. There are, however, two types of cases in which excision may be considered, small ulcers of the anterior wall with little scar formation, and ulcers which have been the cause of bleeding. The first group, that is, small duodenal ulcers of the anterior wall, may be safely removed by puncture with the cautery, the opening closed, and a gastro-enterostomy performed. The mortality rate following such operations will be under 1 per cent., and the end-results will be excellent in 85 per cent. of the cases. In the uncomplicated case, however, these results do not show any clear advantage over gastro-enterostomy.

Bleeding Type of Ulcer.—Experience has shown that an ulcer which has been the cause of bleeding may again bleed if it is not excised. I found that, if the ulcer was not excised in cases in which there was a history of hemorrhage before operation, 13 per cent. of the patients had hemorrhages after operation, even though all other symptoms have been completely

relieved. Therefore, particular efforts were made to excise all ulcers in such cases, whether in the duodenum or stomach. As there are sufficient reasons for the routine excision of gastric ulcer, other than a history of bleeding, this practice has not given rise to any new problems in the surgery of gastric ulcer, but it has in the surgery of duodenal ulcer.

The common location for duodenal ulcers, whether or not they have been complicated by hemorrhage, is on the anterior wall of the duodenum, and fortunately in this situation they can easily be excised either by cautery or knife. Multiple duodenal ulcers are found in 5.13 per cent. of cases, and this fact should be kept in mind when dealing with the bleeding type of ulcer.

Careful exploration, first by palpation, followed by inspection of the anterior wall through the opening made by the excision of the ulcer, is imperative under such circumstances, and will not infrequently reveal unsuspected lesions in some other portion of the duodenum, usually the posterior wall. Resection of the duodenum may be necessary to remove satisfactorily one or more ulcers; the incidence of subsequent hemorrhage, when such bleeding ulcers, whether gastric or duodenal, are radically dealt with, has been reduced more than one-half. Hemorrhages may recur, however, even after careful exploration and radical excision of all lesions, and it is then probable, unless new ulceration has occurred, that the hemorrhages are dependent on causes extrinsic to the stomach, operating through the liver.

The cautery is valuable in its applications to three groups of cases (1) small gastric ulcers in any situation. (2) ulcers of any size in a situation of difficult accessibility, and (3) bleeding gastric or duodenal ulcers.

CANCER OF THE COLON*

By ROBERT T. MILLER, JR., M.D.
OF BALTIMORE, MD.

FROM THE SURGICAL DEPARTMENT OF THE JOHN HOPKINS UNIVERSITY AND HOSPITAL

THE activities of the American Society for the Prevention of Cancer and allied groups, have tended in a way to centre the interest of the profession and of the lay public as well upon superficial cancers. There can be no doubt that this educational campaign has resulted in great improvement in the general situation, for persons afflicted with malignant disease of the mouth, the skin, or the breast are today seeking advice much earlier than formerly, and in addition many doubtful conditions proven on close study to be benign are coming to observation; in a general way the idea that it is best to seek help early seems to be slowly making progress, against the hitherto prevailing sentiment of the lay public to conceal such afflictions. Cancers of superficial situation of course form the most favorable group for this educational type of attack, since they are usually obvious and the patient's attention is attracted early in the disease. A different problem, however, is presented by deeply situated cancers, for, rather than the growth itself, it is commonly the secondary effects of the growth which attract attention, and these are not infrequently so insidious in onset and development that the patient fails to appreciate their significance until too late. It is not uncommon to find that the secondary effects, that is to say, the symptoms, of a deeply situated cancer have been regarded so lightly by the patient that the physician's diagnosis of cancer quite fails to convince the sufferer of the seriousness of his malady. Pain is, unfortunately, not a symptom in the early stages of malignant growth. Pain is a late sign and due not to the growth itself but to the secondary effects of the growth; in gastro-intestinal cancers pain is perhaps most frequently due to infection, which does not occur until the surface has been broken, and even then with an open lesion severe acute pain is not the rule. As a corollary, cancers of the gastro-intestinal tract usually cause the patients to seek help because of things other than pain; but when a cancer has been present long enough to cause these things—as, for instance, a tumor, loss of weight and strength, or anemia—there is but little chance of cure. The percentage of cures of cancer of the stomach or of the rectum is very low. There is a rather general opinion that cancers of the gastro-intestinal tract which produce obstruction are favorable as compared to those which do not produce obstruction, since this feature forces the patient to seek advice. Cancer of the colon is commonly thought of

* Read before the American Surgical Association, May 31, 1923.

as a tumor prone to produce obstruction. We find furthermore a fairly frequent expression of the opinion that cancers of the colon are relatively slow in their rate of growth, and that they metastasize late. If these opinions represent the truth of the matter, it must follow that the ratio of cure following resection is materially higher for the colon than elsewhere in the gastrointestinal tract.

The cases of cancer of the colon, exclusive of the rectum, which have been admitted to the Johns Hopkins Hospital from 1889 to 1919, together with such as are represented by materials sent to Doctor Bloodgood's laboratory during this period though operated upon elsewhere, have been studied in an effort to

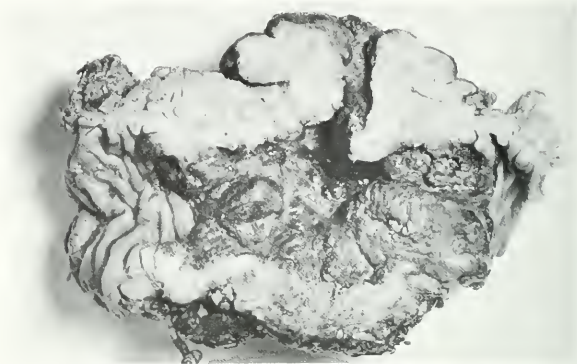


FIG. 1.—P. N. 32666. Adenocarcinoma of the transverse colon, gross specimen. The bowel has been divided longitudinally. Note the large fistula from the colon into the stomach. The excised portion of the wall of the stomach presents the shape of a mushroom on the superior edge of the bowel.

ascertain, among other things, whether these commonly held opinions have an actual basis in fact. The circumstances under which any such group of cases has been assembled are of importance when one attempts to interpret the facts resulting from such a study. This series represents the work of a good many operators, perhaps fifteen in all, and a fairly large percentage of the operations were made by men relatively young in surgery. Practically all of the operators were working under the same conditions, and their surgical efforts represent the result of identical training, but in respect to experience, surgical judgment, and technical ability this series is not entirely comparable to the work of one man. Treatment was uniformly based upon the conviction that if excision was to be made at all, the more radical it could be made within the limits of safety the better; in other words, when feasible there was made a deliberate effort not merely to relieve the patient of an ulcerating mass or of

CANCER OF THE COLON

obstruction, but to effect a definitive cure. The primary growth was excised, and insofar as the conditions governing the individual case permitted, attempt was made to remove also the glands draining the site of the growth. During this period of thirty years the scope of the operation of resection has been gradually extended until, at present, there would seem to be little hope of material improvement in this regard. If then this series of cases may be accepted, within limits, as indicating the effectiveness of our present-day treatment, a study of the results would appear to be of value. The group is made up of 129 cases of cancer of the colon exclusive of the rectum, and covers a period of thirty years beginning in 1880.

Consideration of Clinical Features.—Of the cases studied 77 are male and 42 female, information as to sex being lacking in 10. The ages are shown in the following table:

17 years	1	
20 to 29 years	12	
30 to 39 years	17	
40 to 49 years	28	40.5% of all cases
50 to 59 years	32	
60 to 69 years	21	
70 to 79 years	6	
80 to 84 years	2	
Not stated	10	
<hr/>		
Total cases	129	

Fifteen per cent. of the patients were less than 35 years of age.

There are three quite distinct groups to be recognized at the time these patients seek advice; namely, those in acute intestinal obstruction or who have survived such an attack in the past, those who have had definite chronic partial obstruction which has never become acute, and finally those whose history offers no evidence of obstruction. These three groups apparently have a definite mutual ratio, the acute obstruction group representing 19 per cent., the chronic obstruction group 41 per cent., and the non-obstructive group 39 per cent. In other words, of 10 cases seeking advice 4 will give a definite history of chronic obstruction, 4 will present no evident features of obstruction, and 2 either will be in acute obstruction or will give the history of such an attack from which they have recovered. The fact that identical figures were found some years ago by Doctor Bloodgood in an unpublished study suggests the constancy of this group relationship.

The sex ratio within these clinical groups is of little importance; there is a preponderance of men in the chronic obstruction group and of females in the

non-obstructive group. The average age in these two groups is about 50 years, whereas in the acute obstruction group the patients are a little younger (46 years); the average age of the females in the acute obstruction group is 41 years, and that of the males is 51 years. The site of the tumor may be tabulated as follows:

Site of Growth in the Three Clinical Groups

Site of growth	No. cases	Acute obstruction	Chronic obstruction	Non-obstructive.
Cæcum.....	50, 38%	2	24	24
Ascending colon.....	5, 4%	1	1	3
Hepatic flexure.....	12, 9%	2	6	4
Transverse colon.....	7, 5%	4	2	1
Splenic flexure.....	8, 6%	2	3	3
Descending colon.....	6, 5%	2	1	3
Sigmoid.....	40, 31%	12	16	12
Hepatic flexure combined with second growth in ascending colon.....	1			

Among the chronic obstruction cases the outstanding feature is the history of recurrent attacks of colicky pain, nausea and vomiting, without apparent cause or perhaps ascribed to some indiscretion in diet and usually relieved without great difficulty by catharsis. In a few cases (6 of 53) these attacks are unmistakable, for the patients describe the onset of "cramps" leading up to a rather severe colic which culminates in a gurgle with the immediate relief of pain and after the lapse of a brief period of comfort a repetition of this cycle. There is frequently a marked tendency to constipation, occasionally diarrhoea, and at times (11 cases) gross blood in the stools is recognized by the patient. Moderate abdominal pain of fairly accurate localization is not uncommon and there is a complaint of gastric distress or of an indefinite discomfort. Among our cases about every fifth patient in this group has discovered an abdominal mass.

Forty per cent. of the cases do not give a history of obstruction, but with them abdominal pain of an indefinite character is usually present. The pain is rarely severe and is variously described as "dragging," "a sense of weight," or "discomfort," the patient at times placing it rather consistently, as, for instance, in the epigastrium or the right lower quadrant. There is a tendency to refer symptoms to the stomach, and frequent mention is made of distress or soreness in the upper abdomen, belching, loss of appetite, and kindred complaints. There has been some confusion with chronic appendicitis. A tendency to diarrhoea is perhaps more frequent than constipation and is occasionally marked; at times blood in the stools is present. About every third patient in this group has an abdominal mass.

The acute obstruction group is made up of 25 cases, 5 among them giving no history of trouble preceding the advent of an "unheralded" complete obstruction. The history of each of the remaining 20 falls naturally into one or the other groups just outlined, differing only in that the patient

CANCER OF THE COLON

had survived one or more stormy attacks of acute obstruction which were apparently complete for the time being but did not prove fatal. The 5 cases of "unheralded" obstruction represent 4 per cent. of the entire series, and if to this 4 per cent. who have no previous history of obstructive symptoms we add the 40 per cent. who at no time offer evidences of obstruction, it is seen that almost one-half (44 per cent.) of all cases of cancer of the colon lack this tell-tale symptom, which is commonly regarded as characteristic of the disease. The diagnostic importance of this fact is obvious; our figures do not support the opinion that cancer of the colon very



FIG. 2. P. N. 1243. Cancer of the Colon. Gross specimen.

generally produces obstruction. However, as has just been pointed out, close study of the histories shows that, with few exceptions, the cases show certain symptoms which can hardly escape the patients' recognition, and that even though evident partial obstruction is not present in more than one-half, yet those lacking this symptom present other evidences of disease which are quite as obvious and whose explanation would be just as vigorously sought if their possible significance were understood by those so afflicted.

The duration of symptoms in all cases here represented averaged 16 months. In general the patients are seeking treatment somewhat earlier today than they did 25 years ago, but not to a striking degree, for when

this is studied by periods of five years it is found that the present-day duration of symptoms is 13 months as against 19 months 25 years ago. Moreover, the evidence of this series shows that the shortening of this period affects but one of the three clinical groups; the acute obstructions and the chronic obstructions appear to be coming to treatment a little later than they did years ago, and the only group seeking relief earlier than formerly is the non-obstructive group, in which 22 months represents the average duration of symptoms 30 years ago and 8 months represents the average

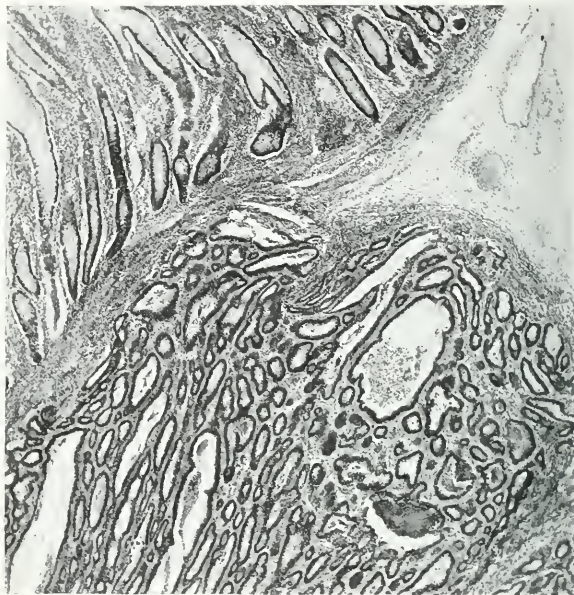


FIG. 3.—P. N. 28918. Adenocarcinoma of the colon. A large majority of the cancers of colon are of this type. The picture shows direct extension of the growth along the bowel wall, undermining the normal mucosa; this is seen very frequently.

duration to-day. Inquiry developed the fact that this improvement was not due to the advent of the X-ray as a help in diagnosis; before this method of examination was in current use there had been a drop from 22 to 13 months in duration of symptoms.

Judging from this series, it appears that for many months these patients consistently present symptoms which can hardly escape recognition, and yet, in the face of this fact, they fail to appreciate the significance of these

symptoms or to investigate the cause of the trouble; this state of affairs apparently presents an excellent opportunity for an effort to bring the public to understand that persistently recurring partial obstruction, or unexplained abdominal pain accompanied by blood in the stools, may be a warning of serious trouble. Reduction of the duration of symptoms offers more than further technical elaboration of the operative treatment.

Pathological Features.—The tumors are almost uniformly adenocarci-

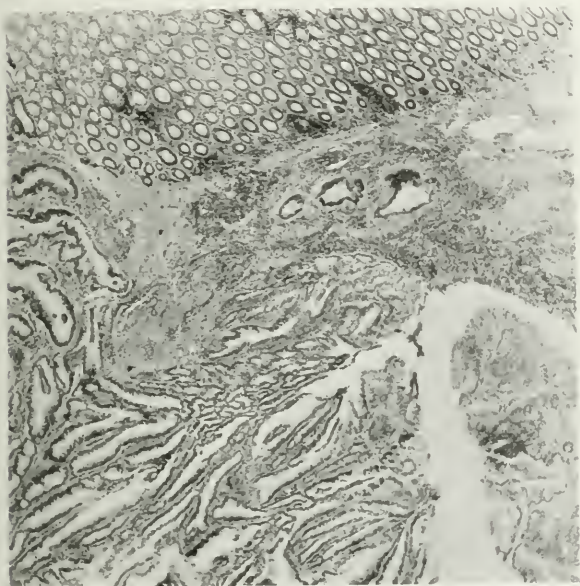


FIG. 4.—P. N. 3161. Adenocarcinoma of the colon showing direct extension of the growth in the bowel wall undermining the normal mucosa. The advancing edge of the cancer is well shown in the lower right-hand portion of the picture.

noma and show a definite tendency to reproduce roughly the glands in the wall of the bowel. Most of the growths have a decided excess of epithelium with a correspondingly limited amount of fibrous tissue, so that there is usually produced a fairly large mass. The extreme scirrhus type resulting from fibrous overgrowth and producing a marked degree of obstruction is infrequent in this series. There is found at times a certain amount of colloid degeneration. In the earlier cases perforation of the bowel with a secondary abscess is not infrequent, there being 16 such cases, the latest of which was recognized in 1913. Excepting one case which apparently shows a carci-

noma developing from a benign adenoma, there was found very little evidence of cancer developing in a preëxisting lesion. The presence of diverticula or of benign ulcers was not observed; if such preëxisting lesions had served as the point of origin of a cancer it is probable that they would have been so completely obscured by the long-standing malignant disease as to escape recognition. These tumors are of course almost invariably single, but there are 4 cases in the series which seem to represent simultaneous development of cancers at two different points. Cancers of the cæcum and sigmoid account for 70 per cent. of the tumors of this series, these two sites being about of equal frequency; the remaining 30 per cent. are scattered indifferently along the other parts of the colon. One-half of the acute obstructions were due to cancers of the sigmoid; almost one-half of the tumors in the chronic obstruction and non-obstructive groups were of the cæcum.

Treatment.—Among 129 cases there were but 70 treated by resection; that is to say, in barely over 50 per cent. was it considered advisable to attempt resection. The earlier cases date back 20 years or more to a period when tardy diagnosis and doubtful technic reduced the number of operable tumors. In 70 resections there were 24 post-operative deaths, an operative mortality of 35 per cent. This is undoubtedly high; in contrast to it stands the fact that since 1919, 14 resections have been made with but one death, a resection of the transverse colon and stomach for cancerous gastrocolic fistula. The cause of death in these 24 post-operative fatalities was as follows: peritonitis, 8; obstruction, 3; embolism, 3; shock, 2; volvulus, duodenal fistula, bronchopneumonia, lung abscess, uræmia, non-functioning anastomosis, "fulminant recurrence," each 1 case, with the cause not stated in an additional case. Of the 8 peritonitis deaths 2 followed the comparatively simple procedure of mobilization of the growth, carried out as the first stage of a proposed Mikulicz operation; these occurred early in the series and probably represent tumors that would be considered inoperable to-day. Six peritonitis deaths were due to failure of the intestinal stitch, four times in lateral and twice in end-to-end anastomoses, all but one of which concerned the sigmoid. When one examines the operative method followed in the 24 fatal cases, it is found similarly that there is a higher mortality ratio among the lateral anastomoses than the end-to-end sutures; namely, 34 per cent. as against 17 per cent., and even though these deaths are not all due to peritonitis resulting from insecure suture, nevertheless the contrast in the figures is striking and possibly significant. Of late years there has been rather a tendency to prefer lateral anastomosis to end-to-end anastomosis, on the assumption that the threat of necrosis of the bowel, due to unavoidable operative interference with its circulation, is more adequately met, but the figures of this table, while by no means conclusive, do not seem entirely to support this impression. It is probably nearer the truth to admit that neither type of anastomosis is dependable if there is any question as to the adequacy of the circulation, and that it is safer to meet this operative problem either by fixing both stumps in an extraperi-

toneal position or, where possible, by resecting enough gut to ensure viable tissues.

There is a marked contrast in the risk involved in resection and suture in the various regions; thus operations on the transverse colon had a mortality of 57 per cent., on the left colon of 41 per cent. and on the right colon of 25 per cent., which conforms rather accurately to the general feeling among surgeons today as to the relative danger. There was a high mortality in 5

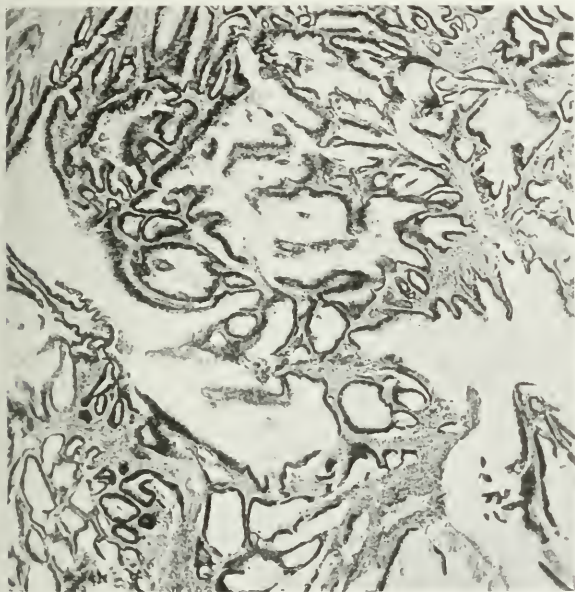


FIG. 5.—P. N. 28443. Cancer of the colon. The growth shows a definite tendency towards a glandular arrangement, with marked production of collagen. In frequency of occurrence this type of growth ranks second, adenocarcinoma without collagen production being first.

resections of the descending colon, among which 3, or 60 per cent., died, and in 4 resections of the splenic flexure, of which one-half died. This bears out the feeling expressed by Dr. John A. Hartwell in a paper read before this association in 1917. The lowest mortality, namely, 24 per cent., is found in resection and lateral anastomosis on the right side, and, excluding the few Mikulicz operations, the highest mortality rate is in lateral anastomoses of the transverse colon; namely, 75 per cent. The transverse colon seems to be a particularly dangerous area, and our figures may perhaps serve as an argument

for a wider resection than many surgeons have been accustomed to make. There is definitely presented the question whether, in cancer of the right or of the transverse colon, it is not wiser to remove the growth and all of the large bowel proximal to it and to restore the continuity of the tract by a lateral anastomosis of the ileum with the remaining colon. Our figures suggest that if the patient's condition permits, the intestinal suture will be more dependable if this plan is followed than if an attempt is made to restore the

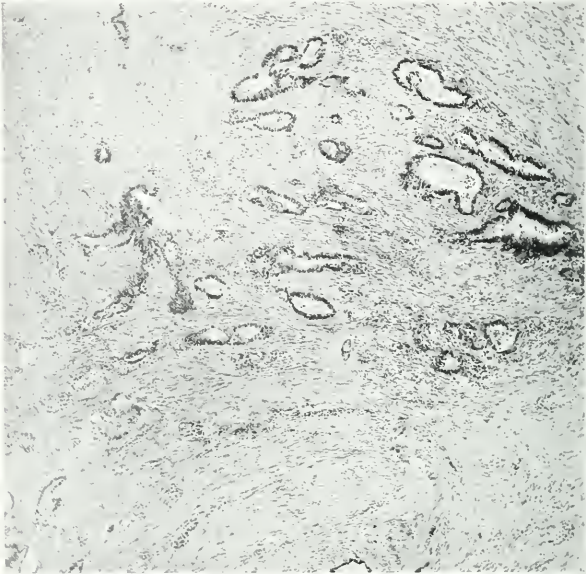


FIG. 6.—P. N. 29017. Carcinoma of the colon. There is a marked tendency towards the production of fibrous tissue, the resulting picture rather suggesting scirrhous cancer. The tendency of the epithelium to maintain a glandular arrangement is still evident. This is the least common type.

continuity by anastomosis of the proximal and distal loops of the colon, but, as will be pointed out a little later, while extending the operation to this limit seems to offer more safety from the standpoint of suture, it fails to offer any additional security with reference to recurrence of the growth. The indication for this extension of the operation, therefore, is not drawn from the figures referring to ultimate cure but solely from the statistics referring to the immediate post-operative result.

Among the clinical groups the lowest mortality from resection was in the

acute obstruction group; apparently this was due to the fact that most of these cases were treated by a preliminary ileostomy or colostomy. Six were submitted to immediate resection, with one post-operative death. Nineteen were submitted to preliminary colostomy; these were obviously the sickest patients of the group, and among the 19 there were 6 deaths following colostomy, but among the 13 surviving colostomy, 12 were resected without immediate post-operative mortality. Thus the resections in the three clinical groups compare as follows with reference to mortality: acute obstruction, 20 per cent.; chronic obstruction, 30 per cent.; non-obstructive, 38.5 per cent.

To sum up: In 70 resections scattered over a period of 30 years there has been a mortality of 35 per cent., and this mortality has been higher with resection of the left colon than the right colon. The most dangerous region has proved to be the transverse colon and its distal extension. No doubt this high regional mortality is due not alone to circulatory difficulties but also to the richer and more virulent bacterial flora of the lower operative field. End-to-end suture in this series has been attended by a lower mortality ratio than lateral anastomosis, but rather than indicating great advantage for either method of restoring the continuity of the gut, our figures suggest that, with tumors of the right or transverse colon, if the patient's condition permits it is perhaps better to excise the cancer and all of the colon proximal to it, restoring the continuity by anastomosing the ileum to the remaining portion of the colon rather than to anastomose colon to colon after resection of no more than the growth-bearing sector of the bowel.

Analysis of Five-year Cures.—Practically all of these patients have been traced and their ultimate fate is known. There are only 13 five-year cures. This represents 10 per cent. of the admitted cases, 10 per cent. of the resected cases, and 28 per cent. of those surviving resection. In other words, the five-year cures represent 1 in 10 of all admitted cases, 2 in 10 of every resected case, and 3 in 10 of every resection surviving operation. In the face of the figures, it requires a considerable degree of optimism to regard cancer of the colon as a "favorable" type of the disease.

Of the 13 five-year cures, 8 came from the clinical group showing chronic obstruction, 3 from the acute obstruction group, and but 2 from the non-obstructive group. Of the 3 cases from the acute obstruction group, none had shown any obstruction symptoms in their past histories; one of these 3 was of the "unheralded" complete obstruction type and had had no previous symptoms, the other 2 had each had abdominal symptoms for two years, but not obstructive in character. Thus in 13 five-year cures only 8, or 60 per cent., had attacks of partial intestinal occlusion which finally forced them to seek advice. It was shown above that about 50 per cent. of all cases of cancer of the colon have a history of partial obstruction. These two figures, *viz.*, 60 per cent. and 50 per cent., are practically identical; their close correspondence forces one to the conclusion that the symptom of chronic obstruction has proved of little aid

toward early diagnosis. If the partially obstructing cancer had forced recognition of its presence earlier and so offered better chance of cure than the others, we would find a distinctly higher cure ratio among those of the first mentioned type; the fact is that our figures show almost the same proportion of chronic obstruction histories in all cases as in the five-year cures. The discrepancy between this fact and the rather generally held opinion is evident.

The relation between the length of time the disease has been present and the chance of cure is clearly shown; the 8 five-year cures in the chronic obstruction cases had an average duration of symptoms of 6 months as against an average duration of 11 months for all the cases of this group. Among the 51 cases of the non-obstructive group the average duration of symptoms was 19 months, but the 2 cures had shown symptoms for only 6½ months preceding resection. In the acute obstruction group there is no difference in this respect between the 3 cured cases and the 22 uncured cases, and it is an interesting fact that only one of the 3 came to operation because of acute unheralded obstruction.

The site of the growth in the cured cases is of interest. The first five-year cure of which we have record was operated upon in 1894 for carcinoma of the cæcum, and the second was also a right-sided growth, a cancer of the hepatic flexure resected in 1899. Of the 13 cases 6, or nearly one-half of the five-year cures, were carcinoma of the cæcum, 2 were carcinoma of the hepatic flexure, 1 was a cancer of the transverse colon, and only 4 were cancers of the sigmoid. It has been held by many observers that from the standpoint of cure the sigmoid is a relatively favorable site because of the frequency of early obstruction with this situation, and it is true that one-half of the acute obstructions occur at the sigmoid, but it has just been shown that the potential help of obstruction as a symptom has not as yet been developed; only 4 of 13 five-year cures had cancer of the sigmoid in spite of the decided tendency toward obstruction at this site.

The type and extent of operation is of very considerable interest. Eleven of the 13 cases were treated by immediate resection and anastomosis; 2 acute sigmoid obstructions in females were treated by preliminary colostomy and secondary resection. In the amount of gut removed there is great variation among the 13 cases, and it appears that, so far as recurrence is concerned, this point is of relatively slight importance provided all of the primary growth is excised. In 8 instances the resection was extensive in the sense that the tumor was removed together with a generous amount of obviously healthy bowel wall; the tissue of only one of these showed metastases to the glands. There were 5 limited resections, *viz.*, 10 cm., 9 cm., 4 cm., 20 cm. (which, however, cleared the edge of the growth on one side by only 3 cm.), and one of less than 4 cm.; none of the 5 showed involved glands. In spite of this variation in extent and more particularly of the decidedly limited amounts removed in at least 2 cases, *viz.*, 4 cm. and less, all of the operations accomplished the same result in that

the patients were clinically free from disease for at least five years and in most instances longer.

All of the material was studied carefully and excepting that from one of the extensive resections, no metastatic glands were found; thus 12 of the 13 cured cases were operated upon at a time in the development of the tumor when complete local removal, no matter how limited a resection this implied, accomplished as much as any operation, regardless of its extent. The one case

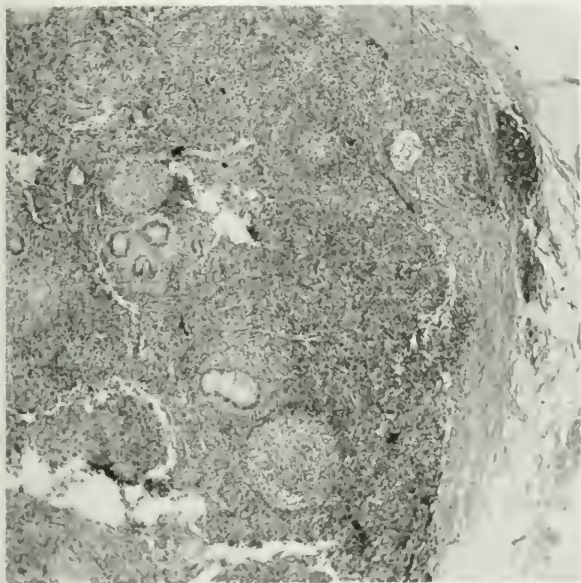


Fig. 7—P. N. 3176. A later carcinoma of the colon, early metastatic to a lymphatic gland. Note the persistent tendency towards a glandular arrangement of the epithelium.

showing metastatic glands remained well over six years and replied to the follow up letters willingly and promptly; at the end of six and a half years her replies stopped abruptly, and it has been impossible to obtain any further information. Although we are ignorant of her fate, it is altogether probable that recurrence of the cancer explains her disappearance, this assumption being strengthened by reason of the low rate of cure in this series as well as by the knowledge that a considerable proportion of the recurrences appear after the end of the fifth post-operative year. If our assumption is correct, there remains no evidence in this series that cancer of the colon is curable by opera-

tion after it has invaded the lymphatic glands. It is unfortunately true that but few of these cases will come to operation before the glands are involved; if it is equally true, as our evidence apparently indicates, that cancer of the colon in this stage of development is rarely if ever curable by operation, there is every reason for us to strive by intelligently directed educational efforts to bring these cases to operation earlier while they are still curable rather than to extend the limits of operation. Judging from this series it seems quite probable that just as much can be accomplished by a limited operation which clears the primary growth as by any operation; there would seem to be no indication for exceedingly wide resections other than circulatory conditions of the colon which appear at times to make ileocolostomy safer than colocolostomy.

There is little to be said of the type of tumor found in the cured cases. Twelve were of the usual adenocarcinomatous character, growths in which the epithelial elements clearly predominate, forming more or less bulky masses which present, in the lumen of the gut, an irregular ulcerating surface outlined

Date of Recurrence

	Number cases	Per cent. of total number cases with recurrence of known date.
1st p.o. year	8	50
2d p.o. year	2	12.5
3d p.o. year	1	6.25
4th p.o. year	1	6.25
6th p.o. year	1	6.25
7th p.o. year	1	6.25
8th p.o. year	1	6.25
16th p.o. year	1	6.25
		75% 25 per cent. of all recurrences appear after the 5th year.

by a thickened rather elevated edge. The ulcerating surface in this type of growth is apt to bleed easily. There is only one scirrhus tumor among the 13; this case is a nine-year cure and the details are sufficiently interesting to merit recording. Following the drainage of a subacute, thick-walled gall-bladder, the patient had a rather stormy convalescence, and on the twentieth day was explored because of a diagnosis of pancreatitis. During the approach to the pancreas the transverse colon was drawn out of the abdomen, and there was found in its distal half a small scirrhus stenosing cancer, which was removed with a rather narrow margin on each side of the growth, no attempt being made to remove the glands. The patient made an uneventful recovery, and nine years after operation was well.

Recurrence.—Among the 26 instances of proved or probable recurrence following resection there are 16 in which the date at which the recurrence was first definitely recognized is known. The information concerning these 16 is recorded in the appended table:

Fifty per cent. appear within the first year and 12.5 per cent. during the

second post-operative year; after that time, however, there seems to be a definite tendency toward tardiness amounting in a few to marked delay. It is not reassuring to realize that the first five years elapsing after successful resection account for only 75 per cent. of the recurrences which will appear; 25 per cent. are first recognized after apparent freedom from disease for more than five years. The length of time which must elapse after operation before a case may be regarded as actually and finally cured is altogether obscure;

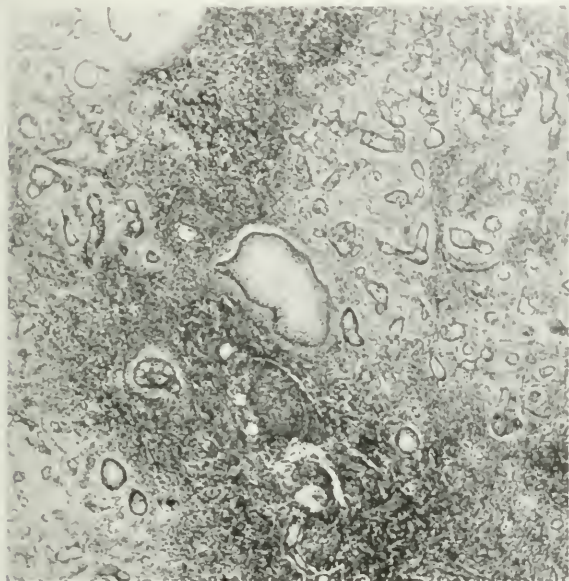


FIG. 8.—P. N. 3835. Cancer of the colon, metastatic to a lymphatic gland. The structure of the metastatic gland is shown in a transverse strip across the middle of the picture, elsewhere the cancerous growth is largely replaced by lymphatic tissue.

it is certain, however, that five years' freedom is not sufficient. In addition to the 16 cases whose date of recurrence is known there remain 10 cases who left the hospital alive but were lost; it is probably not far from the truth to regard these 10 as recurrence deaths, and our figures then show 26 recurrences, which represents 56 per cent. of the resections surviving operation.

There are two cases not taken account of in the figures presented above which illustrate very definitely the insecurity of regarding five years' post-operative freedom from disease as equivalent to a cure. The first of these

cases was a woman aged thirty-eight who came to operation because of dyspepsia and mild constipation present for three and a half months. At operation there was found a cancer of the cæcum which was resected. Sixteen years later this patient died of cancer of the liver; although it is not absolutely certain that this was a recurrence, the probability of such being the case is quite apparent. The second instance is a woman aged fifty-nine, admitted in acute obstruction, which was treated by a preliminary colostomy, followed a little later by resection of a cancer of the transverse colon. Five and a half years later, laparotomy disclosed a mass of carcinomatous glands in the right lower quadrant, which were regarded at the time of operation as metastases from the growth in the transverse colon. Here are two cases showing carcinomatous growth well after the expiration of the five-year limit, and while the metastatic character of the glands in the second case is not wholly clear, it is all but certain that in each instance we are dealing with but the one disease and not with the development of a second independent growth. It would be of extreme interest to know the actual outcome in all of our cancer operations today. There is reason to believe that many cases now classed as cured on the basis of five years' freedom from disease ultimately succumb to recurrence of the original growth; our statistics as to cure would probably not be improved by following this matter in detail.

SUMMARY

The basis of this study is 129 cases of cancer of the colon exclusive of the rectum which applied for treatment during the years 1889 to 1919. At the time of admission only a little over one-half of them presented a history of partial intestinal obstruction. Forty per cent. of the cases had shown no symptoms of obstruction, 40 per cent. had a definite history of chronic obstruction, and 20 per cent. were admitted in acute obstruction or had previously survived such an attack. The history of partial obstruction, when given, extended over the better part of a year before admission for treatment; those lacking this feature presented other symptoms, which had been recognized by the patient for a period of comparable length. Resection produced a five-year cure in 10 per cent. of all the cases admitted and in 28 per cent. of those surviving resection. Examination of the tissue removed disclosed but one case with metastasis to the lymphatic glands, and this case was lost sight of six and a half years after operation; inasmuch as 25 per cent. of the recurrences appear after the end of the fifth year it is reasonable to assume that this patient died of recurrence, in which event there is no evidence in this series to show that cancer of the colon is curable by operation after metastasis to lymphatic glands has occurred. There is reason to believe that if a case is curable by surgical means this result will be achieved just as surely by local excision of the growth-bearing portion of the gut as by an operation of much greater extent; from the standpoint of cure, therefore, limited resection which

definitely clears the growth appears to meet the situation, but the arrangement of the circulation of the colon is such that one may be forced to make a much more extensive resection in order to be assured of the viability of the remaining tissues. Only a small proportion of these cases are now coming to operation at a time when surgery can cure; practically all of them, however, have had definite trouble for months, frequently more than a year. Great benefit would no doubt result from a deliberate educational effort directed toward reducing the period of time which at present intervenes between the first appearance of symptoms and the final decision for operation. Apparently a decided improvement in our cure ratio can be brought about in no other way.

EMBRYOMA OF THE KIDNEY*

By HOMER GAGE, M.D.

AND

DONALD S. ADAMS, M.D.

OF WORCESTER, MASS.

THE kidney during the periods of infancy and early childhood is a frequent seat of malignant disease. One of the responsible new growths has been given the general term embryoma.

Ewing defines embryoma as a tumor composed of tissue from the three germinal layers in more or less orderly imitation of a foetal tissue. This new growth has been classified in the past as sarcoma, hypernephroma and carcinoma;

and it was not until after Birch-Hirschfeld pointed out the existence of a definite embryonal mixed tumor that points of differentiation were reached. The origin of these new growths is purely theoretical, varying from that of aberrant sex cell (Ribbert), to a later teratogenic terminative period, from the renal blastoma (Busse and Muus) as quoted by Ewing.

Grossly the tumors lie within a distended renal capsule with their position suggesting an origin from any part of the kidney substance; and furthermore may present themselves as entirely extra-renal. They may attain

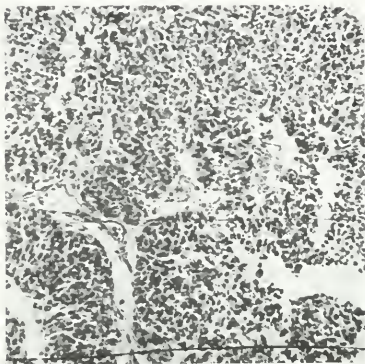


FIG. 1.—Case I. Showing masses of rapidly growing tumor cells, surrounded by a thin, loose layer of connective tissue. In places the cells show attempts at the formation of atypical renal tubules.

very large size, Ewing cites reported cases in which the tumors were from 35 to 40 cm. in diameter, weighing as much as 3580 grams.

Macroscopically they may be solid or cystic, in the latter case closely resembling congenital cystic kidney. In some of the later cases the entire kidney substance has given place to new growth, whereas in the earlier stages normal kidney tissue remains in more or less isolated spots, as in one of our cases, occupying the lower pole.

When cysts appear they may be numerous, glistening, varying in size, filled with clear or straw-colored fluid, and encroaching upon the remaining kidney substance. Where but a few cysts are present they may be in close proximity to each other or isolated.

Microscopically, as described by Mallory, embryoma appears most often as

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a cellular rapidly growing tumor, with little stroma and fairly characteristic cells, which show no differentiation.

On the other hand, when the tumor is growing more slowly the cells are able to differentiate, and various recognizable types of cells and tissues may be formed. Thus muscle, both smooth and striated, fat, cartilage and bone may be seen. A frequent attempt at forming abortive tubules and glomeruli is noted. The individual, undifferentiated cell may be spindle, cuboidal, or giant in type, and usually presents the rapid proliferation characteristic of embryonic tissue.

When we consider the diagnosis and treatment of these new growths, we have the same problem to face that we note in dealing with malignancy in general. More difficult, if possible, for the cases necessarily come into the surgeon's hands late, and the course of the disease is very rapid.

The symptomatology is a handicap, for it is decidedly vague. Frequently the first evidence of trouble is the appearance of a tumor mass. Warnings when they do appear, as in the form of malaise, slight temperature,

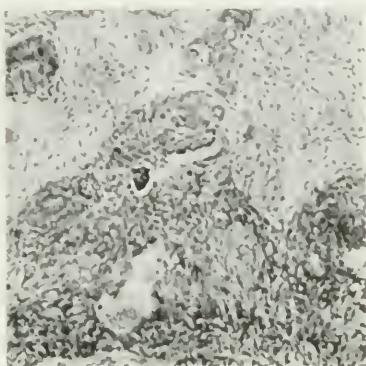


FIG. 2.—Cell 11. Showing rapid mitosis in embryonic tissue. The cells show rapid proliferation and with higher power, many of the cells could be seen undergoing a mitosis. The connective tissue stroma is more pronounced with areas consisting of pleomorphic cells. Here too there is a tendency toward the formation of atypical renal tubule.

abdominal distention or discomfort, diarrhoea or constipation, are so insignificant, that they are not looked upon seriously until too late. Loss of weight, anemia, and hæmaturia usually mark only the advanced cases.

The operative treatment presents two problems; first, the fact that malignant disease has to be dealt with, which in the majority of cases has gained a firm footing; and secondly, the work must be done on a subject young in years, and many times in poor condition. As Mixer points out, the majority of cases are under five years of age; and in his series nephrectomy gave an operative mortality of 35 per cent., and simple exploration 44 per cent. The same author quotes the figures of Loughnane, who noted 7.7 per cent. with nephrectomy, 28 per cent. with simple exploration, and gives the following results obtained:

Four cases well at the end of four years, two at the end of two and one-half years, three lost track of, two dead from recurrence at the end of six months, and one dead of phthisis three months after operation. Mixer further mentions that Loughnane collected 35 nephrectomies from the London hospitals. These showed over 85 per cent. recurrences, 70 per cent. occurring within one year.

Although mention is made in the literature of nephrectomy with removal of the retroperitoneal gland tissue as a possible means of securing an ultimate cure, it is our opinion that such a procedure can only result in even a higher operative mortality than now exists.

In our experience, even those cases which present good risks suffer from

severe shock, greater even, when we have done nothing more than a rapid and nearly bloodless nephrectomy. Very young children withstand major procedures none too well. Furthermore, we believe that the advanced cases, that is, those with anemia or any degree of cachexia are better left alone. After operation intensive X-ray treatment may be tried, although we have yet to see any benefits derived therefrom.

Metastasis is not common in the case of embryoma, the liver

FIG. 3.—Case III. Showing the gross appearance of the kidney in Case III.

and lungs being frequently invaded when it does occur. Local recurrence is, however, the rule, and it makes its appearance usually within six months to two years. After four years, as noted by Loughmane, recurrence is rare.

The three cases we desire to place on record present no unusual features. Two presented cystic changes, and one was quite advanced. All three were composed of the undifferentiated type of cells. Two were operated upon by the authors, and one by Dr. B. H. Alton, to whom we are indebted for the privilege of reporting his case. We also desire to thank Dr. Roger Kinnicutt, Pathologist to Memorial Hospital, for the ultimate diagnosis.

CASE I.—Male, age four years, American. Normal birth and infancy. Some months before admission child's parents noted some enlargement of abdomen, but gave it no particular notice. Four days before admission child had abdominal discomfort, slight temperature and was drowsy. Following day temperature was

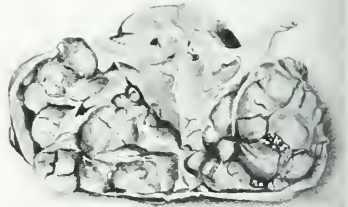


FIG. 4.—Case III. The same kidney laid open. The numerous cysts appear with the normal kidney substance and ureter showing at the upper pole.

EMBRYOMA OF THE KIDNEY

102° F. Admitted to hospital with diagnosis of possible appendix abscess. Urine normal, white count 11,200. Physical examination negative except for a mass, palpable in right kidney region. Laparotomy with right nephrectomy through abdominal route. Left kidney normal. Uneventful recovery.

Gross Pathological Report.—Kidney presents several cysts occupying both poles. Also at each pole are tumor masses, each measuring about 8 cm. in diameter. These are encapsulated and walled off from the rest of the kidney substance. Tumor tissue is soft, friable and grayish in color. Scattered through it are hemorrhagic and cystic areas.

Histological Examination.—The tumor consists of lobular masses of mesenchymal tissue, the lobules being surrounded by a thin loose layer of connective tissue. In places these cells show attempt at the formation of atypical renal tubules.

Diagnosis.—Malignant tumor of mesenchymal origin. Embryoma.

Local recurrences six months after operation. Massive X-ray treatment for several weeks, death nine months after operation.

CASE II.—Female, age two years. Polish. Normal birth, breast fed, no illnesses. Child's parents had noted enlargement of abdomen, formation of a mass and hematuria for one month before seeking medical advice. Admitted from out-patient department with diagnosis of sarcoma of right kidney. Urine loaded with blood and pus. White count 27,300. Hemoglobin, 50 per cent. Red count, 4,072,000. Temperature, 100° F.

P. M. N.—57 per cent. S. L.—17 per cent. L. L.—5 per cent. Trans.—4 per cent. Eos.—17 per cent. Physical examination showed a very pale, weak, but fairly well nourished child, apparently normal except for a mass occupying right kidney region and not freely movable.

Abdominal exploration under ether in the hope that an inflammatory condition might be found and relieved. Advanced new growth existed however, replacing right kidney substance. The tumor was soft, grayish in color, and had adhered to the liver, duodenum and loops of small bowel.

The peritoneal cavity was filled with free bloody fluid. Left kidney normal.

Right nephrectomy after freeing tumor and thereby creating free bleeding. Profound shock noted before operation was completed. Child made an ultimate uneventful recovery.

Histological Examination.—The tumor consists of lobular masses of mesenchymal tissue, the lobules being surrounded by a thin, loose layer of connective tissue. In places these cells show attempt at the formation of atypical renal tubules, and there are also areas consisting of myxomatous cells. Many cells seen in mitosis.

Diagnosis.—Embryoma. Local recurrence large enough to be palpable, four months after operation.

Death from recurrence March 3, 1923, six months after operation.

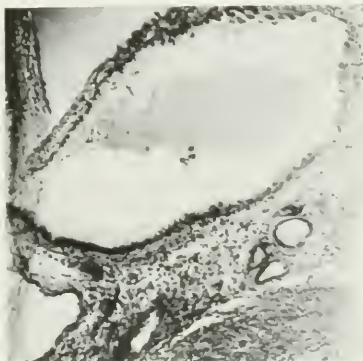


FIG. 5.—Case III. A cross-section of a tumor mass, showing the lining cells. The tumor is composed of cells with clear or high columnar cells. The peripheral areas are gradually merging into the normal kidney tissue. There are areas of connective tissue, hemorrhage and scattered atypical tubules.

CASE III.—Male, age one year. American. Normal birth and infancy, no illnesses. Two months previous to entrance child's mother noted fullness in abdomen on right side below ribs. Child's operation delayed by a cough, but finally admitted to hospital with diagnosis of probable embryoma. Urine normal, white count 16,200. Hemoglobin 65 per cent.

P. M. N.—28 per cent. S. L.—18 per cent. L. L.—45 per cent. Trans.—9 per cent.

Temperature normal. Abdominal nephrectomy. Severe post-operative reaction. Ultimate uneventful recovery. At time of removal a diagnosis of congenital cystic kidney was made.

Pathological Report.—Dimensions after collapse of some of the large cysts, 10 x 6 x 4 cm. Weight of cystic fluid and specimen 275 grams. Kidney tissue pale,

and walls of cysts are gelatinous, gradually becoming dense and fibrous near kidney tissue.

Histological Examination.—

In the remains of the kidney is a large amount of dense connective tissue, with scattered collections of round cells with deeply stained nuclei. In places the glomeruli and tubules are normal in appearance; but for the most part they are either compressed or replaced by dense connective tissue.

Below this cortical layer is a band of connective tissue containing no kidney structures; below this layer is looser connective tissue, mucin-like tissue and scattered atypical tubules. The walls of the cysts are irregular in outline, the irregularity due to the papillae covered with

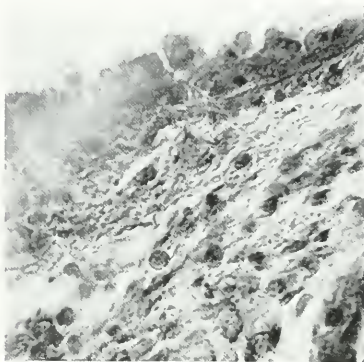


FIG. 6.—Case III. High-power of the lining layers of one of the cysts. These rapidly growing cells vary in shape from flat cuboidal to columnar epithelial cells. The underlying round and connective tissue cells are shown.

cuboidal or high columnar epithelial cells. In the tissue adjoining the cysts are small, irregular cystic areas lined with flat to cuboidal epithelium.

Diagnosis.—Cystic kidney, embryoma. No evidence of recurrence at end of five months.

It is only fair to assume that in view of the usual course of these new growths and the difficulty of arriving at a diagnosis, the mortality will continue to be high. The results of operative interference can only be improved if earlier diagnosis can be made and earlier and more radical excision practiced.

It is not at all certain that this can ever be successfully accomplished. Meanwhile it is probably best to continue doing as radical a nephrectomy as possible, so long as even a very small percentage of cases survive and remain free from recurrence for several years.

We believe, however, in view of the high mortality and high percentage of recurrences that the family should be fully apprised of the gravity of the case and the slight prospect of relief.

CERTAIN FEATURES OF RENAL CALCULUS*

By ELLSWORTH ELIOT, JR., M.D.

OF NEW YORK, N. Y.

THE wide variation observed in the pathology of renal calculus accounts for the great irregularity of its clinical manifestations. Calculus may be single or multiple, in one or both kidneys, possessed of rough or smooth surface, situated in either the parenchyma of the organ or in the pelvis or in both places simultaneously. If in the parenchyma it enjoys little if any movement; on the other hand, in the pelvis small calculi if not adherent to its walls usually are freely movable, and if too large to pass through the ureter may intermittently occlude the pelvic outlet. Furthermore calculi vary in the rapidity of their formation and their growth may be intermittent as the character of the urine becomes more or less favorable to the precipitation of its mineral constituents. That calculi should form simultaneously in both kidneys is a natural inference, yet such an occurrence is the marked exception, and is perhaps accounted for by the fact that the chemistry of the urine collected by ureteral catheterization from either kidney does not always show the same composition and may vary to such an extent as to actually differ in reaction.

Renal calculi, through their irritation, cause an intermittent non-infectious inflammation of the mucous membrane of the pelvis or, if in the parenchyma, of the connective tissue stroma of the organ as well as a productive inflammation of the perinephritic connective tissue proper. This latter condition leads to the formation of more or less dense adhesions between the kidney and its investing capsule, because of which in the course of the operation for the removal of the stone the delivery of the kidney to the surface of the wound may be greatly impeded. By the contraction of this same tissue the pedicle of the kidney may be shortened, and in one instance observed by the writer this contraction was so marked that the poles of the kidney were approximated. The kidney pelvis in consequence was so concealed from view that the calculus within its cavity could only be removed through an incision in the kidney parenchyma. On the other hand, total absence of any change in the perinephritic tissue is well demonstrated in Case I, in which both subjective and objective symptoms indicated a freely movable kidney. The calculus was detected in the course of routine X-ray examination and easily removed through the usual incision in the posterior wall of the pelvis. The writer in the past has operated on many cases of movable kidney, and in no instance was a calculus found in the exposed pelvis.

The writer refrains from any reference to the pathological changes due to pyogenic infection in a kidney containing calculi. Such a condition usually

* Read before the American Surgical Association, May 31, 1923.

develops, if at all, in the later stages of the lesion and after the calculi, by obstruction, have caused distention of the pelvis and calyces.

While renal calculus with or without calculi in some other part of the urinary tract is usually uncomplicated with lesions in other organs, the writer has observed one instance in which there existed a cholelithiasis, another in which a carcinoma of the stomach had been successfully removed, while Case IV shows a tuberculosis of the affected kidney. In Case III, an intraligamentous cyst was first removed.

The gross pathology of renal calculus has thus been briefly outlined, for the purpose of emphasizing the difficulty of correlating the subjective symptoms into well-defined clinical groups. These subjective symptoms therefore, while of relatively little diagnostic value, are at least important in leading to X-ray examination, and for that reason deserve study and consideration. In omitting their exhaustive enumeration it is nevertheless important to call attention to the fact that pain, unquestionably the most constant symptom, is subject to frequent variation. In place of the typical lumbar pain radiating downward and forward along the course of the ilio-inguinal nerve, this symptom may be more or less localized and even referred anteriorly to a point above or below the level of the navel. This is of importance in the differential diagnosis of renal calculus from inflammatory conditions of the gall-bladder, duodenum and pancreas, and strongly emphasizes the need of X-ray examination in these baffling conditions. Rarely pain is conspicuous by its absence. In one such instance recently observed, the patient's attention was attracted by a hæmaturia (Case V). As is well known this symptom, especially in those beyond middle age, strongly suggests malignancy of the bladder. Moreover, at any age, it may be the first indication of a hypernephroma. Fortunately for the patient (aged fifty-eight) investigation of the bladder proved normal while an X-ray of the lumbar region showed a well-defined calculus apparently in the parenchyma of the kidney. The discovery of a renal calculus may be entirely accidental. This is well illustrated in the following history. Case XIII, a man of thirty-five apparently in perfect health applied for life insurance. The urine on microscopic examination was found to contain a small amount of pus which on cystoscopic examination was found to issue from the left ureter. An X-ray then taken showed the shadow of a calculus the size of a lima bean which was successfully removed from the kidney parenchyma.

While renal calculi may thus form without symptoms, the writer believes that this is a very much less frequent occurrence than the corresponding formation of gall-stones.

Rarely pain due to a renal calculus is referred to the opposite kidney. This rare variation, usually considered to be due to some abnormality in the reflex path, is well illustrated in Case XII, in which a different explanation is suggested by the subsequent history of the patient. After the removal of the calculi from the affected kidney the pain persisted at intervals on the right side, occasional X-ray and ureteral catheter examinations proving negative until four years after the operation when multiple calculi were demonstrated

in a radiogram. The explanation referred to is that the right-sided pain was due to the irritation of the urine of the right kidney even before any recognizable precipitation of its mineral constituents had taken place. The exact nature of the change in the chemical composition of the urine responsible for the pain it is impossible to state.

The surgical treatment of renal calculus depends upon their number, location, whether the lesion involves one or both kidneys and the condition of the kidney itself. Single or multiple calculi in the pelvis are most easily and safely removed through an incision in the posterior pelvic wall. This method of approach has gradually superseded the removal of calculi in this location through the kidney parenchyma for the danger of a persistent urinary fistula after the former proceeding proved largely imaginary while the risk of post-operative hemorrhage from divided kidney tissue, occasionally of such an extent as to require immediate nephrectomy, is obviously avoided. The exposure and removal of calculi in the renal parenchyma is possible only after division of the overlying kidney tissue. In this group of cases, the X-ray has proved of the greatest value in determining the number of calculi and their approximate position. This information ordinarily directs the point of attack and defines the limit of the operation so that unnecessary exploration is avoided. The procedure is, however, not always so simple for, as in the case of fractures, the interpretation of X-ray plates is occasionally misleading and confusing, especially when multiple calculi overlap. If for this or any other reason the locating of the calculus or calculi is difficult, valuable assistance is given through the bimanual palpation of the kidney in the course of the operation. In this manoeuvre the kidney is gently compressed from above downward between the tip of the little finger inserted through an incision in the posterior pelvic wall and the index finger of the same or opposite hand on the external surface of the kidney. This method of palpation, first advocated by the writer in a paper published in 1906, has proved most serviceable. Except in those cases of long standing calculi in which fibrosis has developed, the cortex of the kidney so compressed feels both thin and soft, and calculi, even of small size can easily be felt. The nature and direction of the incision of the kidney tissue through which the calculus is to be removed depend upon its character and size. Large branching calculi are best approached through an incision longitudinal along the convex border of the organ. For small calculi, the writer prefers an incision at right angles to the long axis of the kidney. In both it is important to remove the calculus without fracture in order to avoid the possibility of recurrence from a small fragment left *in situ*. After the removal of the calculus the divided kidney tissue is best approximated with one or more mattress sutures of catgut. Nephrectomy is always justified in calculous pyonephrosis, and in cases in which the kidney parenchyma is studded with a large number of calculi provided that an X-ray examination shows no calculi in the remaining kidney, and that satisfactory renal sufficiency can be demonstrated in the urine

collected from that organ by ureteral catheterization. If a nephrectomy is to be done, it is well to remember that the pedicle of the affected kidney may have been shortened by the contraction of perinephritic tissue associated with long standing inflammation of both the infectious and non-infectious types, and that, especially on the right side, which normally has a shorter pedicle, a subcapsular removal of the organ may prove the safest measure. When both kidneys are involved it may be difficult to determine the appropriate treatment especially if the calculi are multiple. In general, the removal of the calculi at separate times may be attempted if they appear to be limited to the kidney pelvis or if, in the parenchyma, their number is sufficiently small to justify a reasonable expectation of operative success. Nephrectomy of the more involved kidney is rarely justifiable except for pyonephrosis and then only when an adequate renal sufficiency of the remaining organ can be demonstrated.

In general the immediate operative results in cases of renal calculus are very satisfactory, especially in the removal of calculi situated in the pelvis only. This operation causes little if any disturbance in the function of the kidney, the urine not being perceptibly diminished in quantity and containing during the first twenty-four hours a considerable quantity of clotted blood. During the first day or two there is a little discharge of urine in the dressing, which after that interval entirely disappears. That the operation is not devoid of risk, however, is shown by two fatalities, one in the writer's series of cases and the other in that of a skilled and experienced colleague. In the former instance, the removal of the calculus through an incision in the kidney pelvis, a sudden rise of temperature appeared after an uneventful convalescence of eleven days and varying between 105 and 108° , continued for five days until the patient's death. The wound drained satisfactorily during the entire period and no subjective or objective symptom could be elicited to account for the unusual course. Unfortunately no autopsy could be obtained. The other case, seen in consultation by the writer, occurred in a strong robust adult of twenty-one. Twenty-four hours after operation, shock suddenly developed with death on the following day. The removal of the calculus through a pelvic incision had been quickly done with a minimum of kidney manipulation. An autopsy showed no hemorrhage, no involvement of the kidney and no lesion that could account for the unfortunate result.

While, as has been stated, no immediate change in the function of the kidney from which the stone has been removed is apparent, the possibility of gradual development of diminished excretory power of the affected organ must be taken into account. Routine post-operative ureteral catheterization, continued for a sufficient length of time, would unquestionably decide this question. It has only been done in a few of the writer's cases and usually some months after the removal of the stone in which the recurrence of lumbar pain pointed to possible recurrence. In these scattered instances this procedure showed symmetrical kidney excretion. Another although uncommon proof of the persistence of normal kidney activity is furnished by the post-operative renal fistula. In Case VI such a fistula discharging a considerable amount of

urine persisted for over a year after a removal of a calculus in the pelvis through an incision in the kidney tissue.

The writer wishes to emphasize the need of careful investigation of the chemistry of the urine of the affected kidney both before and after operation, comparing the respective analyses with each other and with the urine of the normal side in order to discover evidence that, however, imperfectly, may indicate the character of the changes in the metabolism that predispose to, if they do not actually cause, the formation of calculi.

No part of the subject is more interesting than the consideration of recurrence after operation. The complete removal of one or more calculi from the kidney parenchyma or pelvis relieves the patient of one or more foreign bodies, without in any way affecting the cause of their formation. It is not strange, therefore, that calculi recur. Perhaps it is strange that recurrence is not more frequent. Recurrence while more common after removal of calculi from kidney parenchyma may also occur after the removal of even a single calculus from the pelvis. To this class belongs Case XI, in which after a succession of recurrences in different locations a terminal infected pyonephrosis developed, requiring nephrectomy. The writer is especially apprehensive of recurrence after removal of calculi in the parenchyma, for the reasons that in this situation, calculi are so frequently multiple, and that one or more may be so small as to escape detection not only by means of the X ray but by careful palpation of the kidney itself in the course of operation. Strictly speaking such a condition is not a recurrence, but an excusable failure to detect calculi in the early stage of their formation. The writer believes, however, that a true recurrence may develop due to the excusable failure to relieve the predisposing and exciting causes of altered metabolism. That the parenchyma, after the removal of calculi, may remain free from recurrence has been the writer's experience in half a dozen patients, who have shown no subjective symptoms or visible urinary changes for periods of from 2 to 16 years. Such evidence is obviously faulty without the support of X-ray and ureteral catheterization. However, the patient free for 16 years was accepted as a good insurance risk much, it must be confessed, to the surprise of the writer. The constant shifting of urban population is responsible for the failure to trace other patients operated on for this condition, especially those treated in hospital wards. The fact, however, that few cases of recurrence in patients operated on by other surgeons, have been encountered, indicates at least that recurrence on the whole is uncommon. Nevertheless it must be conceded that a complete removal of all calculi, even of those limited to the kidney pelvis, does not by any means insure a permanent cure. In spite of measures to prevent recurrence, such as the regulation of the diet and the use of a sufficient quantity of alkaline salts to maintain a neutral or slightly alkaline urine continued indefinitely, recurrence may occur. In this respect renal calculus is analogous to gastric ulcer in which, no matter how radical the operative treatment, even the most careful subsequent hygienic and dietetic measures fail at times to prevent recurrence.

While the necessity for the radical removal of renal calculi can never, in

all probability, be avoided, future progress in the treatment of this condition surely lies in the development of the knowledge of those changes of tissue metabolism which predispose to their formation and to the discovery and adoption of suitable measures to regulate and maintain normal metabolic changes in the tissue cell.

CASE REPORTS

CASE I.—Female, fifty-two. History of dull lumbar pain, especially on walking, thought to be due to movable kidney. After an attack of acute appendicitis the pain disappeared until two and one-half years before admission to the hospital, since when it has persisted until the present time. There has been increased frequency of micturition with occasional hematuria. A calculus, found on X-ray examination, rough in character and free in the kidney pelvis, was removed by pyelotomy with relief of the local symptoms.

CASE II.—Adult male. Several similar attacks to the present one for the past five years. Present attack began to-day, before admission to the hospital, with vomiting, chills, headache, bloody urine and pain in the left lumbar region. There was also increase in frequency of micturition. On operation a stone, three-quarters of an inch in diameter, was found in the pelvis of the left kidney, concealed by the approximation of the kidney poles, curved over by the contraction of peri-renal connective tissue. The kidney was delivered after the removal of the twelfth rib. The stone was felt but could not be attacked through the pelvis, owing to the overlying kidney tissue. A silk ligature was passed upward through an incision in the pelvis through the overlying kidney tissue which was then divided by a sawing motion. The calculus was then removed and the divided kidney tissue which bled profusely was easily controlled by suture.

CASE III.—Female, forty-three. History of frequent micturition for eight or nine years with dragging pain in the legs. Five months ago was said to have voided gravel. Two weeks after an uncomplicated removal of an intraligamentous cyst on the right side severe pain developed on the left side ileocostal space, radiating to bladder with local tenderness and constitutional symptoms of fever. Gradual subsidence in three days. Ten days afterward, onset of attack with sudden sharp pain over the right kidney with nausea, vomiting, marked diminution in the quantity of urine and the formation of a mass in the right hypochondrium the size of an orange. Catheterization of the left kidney showed a normal condition, while that of the right showed obstruction four inches above the bladder.

On operation a pyonephrosis was found with calculi in the sac and the ureter four inches below the brim of the pelvis was found to be completely blocked by a mass of calculus detritus. The purulent material had a distinct colon odor. Nephrectomy was done. There was no apparent connection between the occlusion in the ureter and the intraligamentous cyst which was excised three weeks before the nephrectomy. Recovery.

CASE IV.—Female, twenty-four. In September, 1910, stone was removed from the pelvis. One month after operation increased frequency, with burning pain, was noticed and has continued for the past six months. For the week prior to admission there was a recurrence of the old lumbar pain which existed prior to the removal of the calculus, with purulent intermittent urine but no blood. X-ray showed two calculi in the parenchyma. Nephrectomy. Examination of the kidney showed multiple calculi in the parenchyma with evident fibrosis, and, on microscopical examination, tuberculosis with degeneration of the parenchyma.

CASE V.—Male, thirty-two. Fourteen months ago, left kidney was explored by another surgeon after three attacks of severe stabbing pain in the left flank radiating to the left groin and scrotum. The operation was terminated uncompleted

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on account of hemorrhage. Five months later a recurrence of the pain with abscesses in the scar. A large branching calculus in the pelvis of a pyonephrotic kidney which had been disclosed by an X-ray demanded a sub-capsular nephrectomy, from which the patient recovered.

CASE VI.—Male, fifty. For the past ten years patient has had attacks of pain, passing of stones, of increased frequency of micturition with burning sensations at the end. Three stones found on X-ray, were removed by nephrotomy from the right kidney pelvis to the wall of which they were adherent. Kidney tissue was sutured. Several months after the operation, similar symptoms developed on the left side which continued for two years, when through a left nephrotomy a stone was removed from the parenchyma of the left kidney to which it was so adherent that it was fractured in its removal. Following this operation the patient developed a lumbar urinary fistula which continued to discharge for nine months. After the second operation catheterization of the right ureter showed normal urine and examination with the X-ray failed to disclose any calculus. One year later a second catheterization and X-ray showed a normal condition of both kidneys.

CASE VII.—Male, thirty-two. Pain referred for almost four years to the right upper quadrant of the anterior abdomen, coming on in various attacks especially after exercise. Fourteen months before admission a stone was removed from the right kidney at Rio Janeiro. (The patient was shown the calculus.) Three weeks later another severe attack of renal colic and, on admission to the hospital, X-ray disclosed the presence of a calculus with a rough surface which was readily removed from the kidney pelvis. The kidney was invested in dense adhesions.

CASE VIII.—Female, twenty nine. Dull aching pain terminating in the formation of a large hydronephrotic sac which when opened contained a small piece of gravel in the pelvic mouth. As the left ureter had not been found on cystoscopy no nephrectomy was done. Subsequently the left ureter was catheterized and the left kidney found normal. A right nephrectomy was then done disclosing a large number of calculi in the old hydronephrotic sac.

CASE IX.—Male, twenty-nine. History of lumbar pain for the last twelve years with several attacks of sharp colic. During the eight months preceding admission to the hospital, pain had become much worse.

Operation showed one calculus in the pelvis and a second one in the parenchyma. The former was removed through an incision in the pelvic wall, the latter by nephrotomy with suture of kidney tissue.

CASE X.—Male, twenty-two. History of ten years pain of sudden paroxysmal character with no urinary symptoms. A nephrectomy was done for multiple calculi with loss of kidney tissue. In addition patient suffered from pulmonary tuberculosis. The left kidney was normal. Satisfactory recovery.

CASE XI.—Male, twenty. History of pain in right flank radiating to penis and testis, of four months duration. A stone was found in kidney parenchyma a short distance above the pelvis but not communicating with that cavity. It was removed through a vertical incision in the kidney tissue. Bimanual palpation failed to disclose other calculi. Six months later X-ray examination showed no stone in either kidney or in the pelvic ureter.

Three years after operation, pain appeared in the right flank radiating into the right testis. Patient frequently noticed the passage of thick white mucus in the urine. X-ray showed a large dense shadow on the right side of the pelvis in the line of the ureter. Ten days later a large calculus was removed by the anterior extraperitoneal route from the right ureter near the pelvic brim. Six weeks later the patient required a right nephrectomy for a condition of pyonephrosis, no stone being found in the kidney.

CASE XII.—Female, thirty. Four years ago patient first noticed pain on the right side radiating first to the lumbar region and then to the mouth of the urethra. X-ray showed a number of calculi in the left kidney and none on the right side, the side of the pain. These were removed by both pyelotomy and nephrotomy from the pelvis and kidney parenchyma.

Six months after operation, patient still complained of pain on the right side. Both urethral catheterization and X-ray proved negative.

Three years after operation, patient still complains of pain on the right side, coming on in attacks similar to those experienced before the calculi were removed. The patient was confined to bed for a time without evident change in the character of the urine, the passage of which was noticeably increased during the day. Again X-ray examination was negative. The result of catheterization of the ureters was as follows: The urine from the right kidney was alkaline. It contained small numbers of both red and white blood-cells. The amount passed during the time of observation was two c.cm. The urine from the left kidney was acid with the same cellular content as the right. The amount passed during the period of observation was 25 c.cm. The catheter passed easily up both ureters without sign of obstruction. The flow from the left was free and normally intermittent. That from the right was delayed and only appeared after the injection of saline solution. Neither urine was macroscopically abnormal. With the catheters *in situ* an X-ray of the urinary tracts was negative.

Fifty-three months after operation there was no change in the subjective or objective symptoms.

Fifty-nine months after operation.—For the past month patient has suffered from attacks of pain on the right side with chills and fever. An X-ray examination showed a large branched calculus in the pelvis of the left kidney with two adjacent smaller stones and one on the right side (the first appearance of a calculus in this kidney) somewhat smaller and irregular. During the following six months, patient passed several small calculi per urethram. Patient still under observation.

CASE XIII.—Male, thirty-six. No previous indication of renal calculus. On examination for life insurance a small amount of pus was discovered in the urine. This led to a cystoscopic examination in which the urine from the left ureter was found to be cloudy. X-ray examination then disclosed the shadow of a calculus the size of a lima bean in the parenchyma of the left kidney which was successfully removed. The patient subsequently obtained life insurance.

CASE XIV.—Male, forty. Patient gives a history of occasional attacks of lumbar pain of short duration becoming of late more frequent extending forward and downward. Persistent tenderness in the lumbar region has followed these attacks of pain. During the attack the patient has noticed blood in the urine.

On operation a calculus was removed from the pelvis of the kidney through an incision in the posterior pelvic wall. Wound drained in the usual manner. Convalescence uninterrupted for eleven days when without discoverable cause patient developed a temperature of 104°. This continued without marked remission for four days, varying from 104 to 108°, when the patient died. There was no subjective or objective symptom in the abdomen or wound to account for this unusual clinical course. Unfortunately no autopsy was permitted.

CASE XV.—Male, fifty-nine. Patient always well and strong. Recently without warning patient noticed blood in the urine. This was repeated occasionally and in varying quantity for a fortnight. There was no pain or discomfort of any kind. The hematuria was the sole symptom. An X-ray of the kidney showed a small concave more or less pointed calculus. No operation, patient being kept under observation.

OSSIFICATION IN KIDNEY STONES ATTACHED TO THE RENAL PELVIS*

BY DALLAS B. PREMISTER, M.D.

OF CHICAGO, ILL.

THERE exists a tendency to ossification in the organs of the urinary tract, under certain experimental and pathological conditions, which is greater than that in any other system of organs. Some of this ossification appears to be related to the direct and continuous action of the urine upon altered tissue bordering on the urinary channel. That in the kidney results from the fact that it is an end organ, and interference with its blood supply is followed by degeneration, which creates a field for calcification and ossification that is more favorable than that produced in other organs. Experimentally, bone has been produced in ureter, bladder and kidney. Strauss¹ repaired defects in ureters in dogs with pedunculated flaps of fascia and found that in every instance a layer of bone formed in the portion bordering on the lumen, converting it into a rigid tube. Neuhoof² repaired defects in the bladders of dogs by transplantation of fascia lata and found regularly that the portion of graft bordering on the lumen became ossified. Calcification was found to begin six days and ossification seventeen days after operation. There was no associated stone formation nor incrustation of bony plaque bordering on the urinary channel in either set of experiments. An epithelial lining grew from the margins and soon covered the entire bony surface, so that in the older experiments no bone bordered on the lumen. The pelvis of the kidney of the mink³ and of the coati mundi⁴ is not infrequently invaded by the worm *eustrongylus gigans*, interfering with drainage and producing hydro-nephrosis with reduction of kidney substance. When these changes are marked, ossification occurs regularly in the thickened fibrous walls of the pelvis. Sacerdotti and Frattin⁵ were the first to show that ligation of the renal artery in rabbits is followed by calcification and ossification in the necrotic kidney. Asami and Dock⁶ ligated both renal artery and vein of the rabbit's kidney and found that bone formation began independently of calcification in the loose vascular connective tissue close under the transitional epithelium of the calyces. Bone later formed in the calcified areas through erosion of the lime plaques and deposition of lamellae by cells derived from fibroblasts.

In man, ossification in the urinary tract has been reported only in connection with the kidney and but rarely. However, calcification in the kidney is a common finding, especially in the pyramids, in acute destructive kidney lesions, as bichloride of mercury poisoning, and in old age, osteomalacia, osteitis fibrosa and metastatic carcinoma of the bones, in which conditions

* Read before the American Surgical Association, May 31, 1923.

there is mobilization of a considerable part of the stored-up calcium of the body. Localized calcification occurs in infarcts and degenerated inflammatory areas, and there may be subsequent partial replacement of the lime salts by bone. I have seen partial replacement by bone of calcified areas in tuberculosis of the kidney and in hypernephroma.

A search of the literature fails to show a recorded instance of ossification in connection with kidney stone, either in the pelvis of the kidney or within



FIG. 1.—Case I. Röntgenogram showing circular area (a) of slight density in stone.

the stone itself. Also, there seems to be no record of stone attached to the pelvis of the kidney, either by a pedicle or as an incrustation on the pelvic wall. The three stones here to be described were attached to kidney lining and were composed partly of living bone.

CASE I.—J. M., male, age thirty-six, entered Presbyterian Hospital, September 28, 1921. He gave a history of attacks of pain and soreness in the left kidney region extending over a period of twenty-five years. Three months previously there was a severe attack of renal colic, and since then the urine has been slightly cloudy at times. Blood was noticed first two days ago. Examination revealed slight tenderness in the left kidney region. A röntgenogram showed numerous stone shadows in the region of the left kidney (Fig. 1). There was a large, dense, branching shadow in the region of the pelvis. There was a circular area of very faint density in the lower portion of this dense shadow, which comprised

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one-half of its diameter. The urine was acid in reaction and showed many pus cells and erythrocytes. On ureteral catheterization by Doctor Herbst, clear urine was obtained from the right kidney and cloudy urine, containing many pus cells and erythrocytes, from the left kidney. Cultures of the urine from both kidneys were negative. The reaction of the specimens of urine from the two kidneys was not determined separately. Left nephrectomy was performed by Doctor Bevan, October 3, 1921.

Pathologic Examination.—There was a small amount of perinephritis. On section of the kidney there was moderate dilatation of pelvis and calyx and reduction in height of pyramids. There were several small stones in the calyces, especially of the lower portion; and one large oval, branching, mulberry stone in the pelvis and extending into the upper calyx. Stone 1. Pelvic wall was ulcerated in places from contact with stone. The dimensions of the stone were 4.0 cm. by 2.5 cm. by 2.0 cm. After removal it was discovered that a fibrous pedicle ran into the stone at the fork.

This had been broken before it was observed and its exact point of attachment to the pelvis was not located with certainty, but it was probably on the portion of pyramid that lay in the fork of the stone. The stone was broken and found to be composed in its lower portion of a grayish nucleus comprising one-half of its diameter and extending to the surface at the point where the pedicle entered. (Fig. 2.) This portion had the appearance and consistency of spongy bone. The rest of the stone was composed of dense superimposed lamellae which were dark brown in its peripheral portion and grayish to light brown in its deeper portion, where it came in contact with the central nucleus. A roentgenogram of the reconstructed stone (Fig. 3) showed that the area of slight density corresponded to the nucleus resembling bone. Microscopic examination of a section from the nucleus showed it to be composed of living spongy bone containing marrow, fat, loose fibrous tissue and capillaries in its cancellous spaces (Fig. 4). A section of a decalcified portion at the line of junction of bone and stone showed, along one side of stone, a layer of crystals difficult to identify but apparently mostly calcium oxalate. They were invaded by connective tissue in which bony trabeculae had formed (Fig. 5). Near the base of the pedicle, white fibrous tissue filled a considerable area



FIG. 2.—Case I. Drawing of kidney stone. A, whole pedicle attached; B, longitudinal section with interior of stone.

of the nuclear space and on one side bordered directly on stone, which was made up of a layer of calcium phosphate crystals. Chemical analysis of a portion of the stone showed the inorganic elements to be composed of calcium oxalate 97 per cent. and calcium carbonate 3 per cent. The inorganic elements comprised 96 per cent. of the total dried calculus examined. There were traces of magnesium and phosphorus, but the murexide test for urates was negative. Apparently the periphery of the bone was in contact with an inner layer of stone, composed mostly of calcium oxalate in some portions and of calcium phosphate in others.

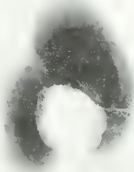


FIG. 3.—Case I. X-ray of stone showing lamination and area of slight density corresponding to bone.

The order of development of the pathological picture presented cannot be definitely stated, but at the time of examination the stone was attached to the pelvis by a fibrous pedicle and its interior was composed of a large nucleus of bone, which, from microscopic examination at the line of junction, had been gradually replacing the stone. It is difficult to say whether the stone was attached from the beginning at a point of break in the mucous membrane of the renal pelvis and grew about the tip of a fibrous pedicle, which itself had already calcified and later gradually underwent metaplasia into bone, or whether the stone formed free in the renal pelvis and by its large size and roughened surface eroded the pelvic lining and became attached secondarily by an invading fibrous pedicle, the tip of which in turn ossified by metaplasia and replaced bone.

CASE II.—J. P., male, age twenty-four, entered Presbyterian Hospital, January 15, 1923, giving a history of occasional attacks of pain in the right renal region during the past eleven years. During the past two months there had been increased frequency of and burning on urination. Physical examination was negative, aside from moderate tenderness and rigidity in the right kidney region. A röntgenogram

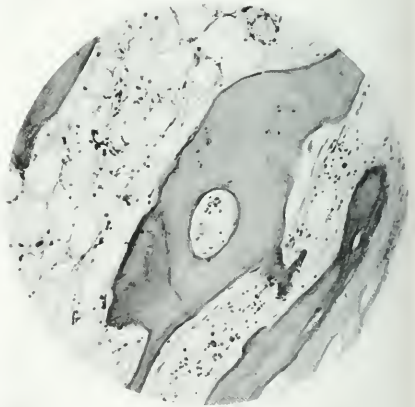


FIG. 4.—Case I.—Photomicrograph of bone.

(Fig. 6) showed several shadows of stones in the right kidney. There was one large, dense, branching shadow in the region of the renal pelvis. No definite area of lessened density could be made out within it. The urine was alkaline and

contained many pus cells, triple phosphates and amorphous urates, and catheterized specimens showed pus from the right kidney, but none from the left. Staphylococcus was grown in cultures of urine from the right kidney. The reaction of the urine obtained separately from the kidneys was not determined, but since the bladder was found normal and its urine alkaline, the urine from the right kidney must have been alkaline. Right nephrectomy was performed by Doctor Bevan, January 20, 1923.

Pathological Examination.—There was some perinephritis and a slight cystic bulging of a portion of renal cortex opposite the pelvis. On section of the kidney, the pelvis was found to be slightly dilated and the calyces markedly so. At the middle of the organ there was complete destruction of a lobule of kidney with a thin-walled sacculcation of a calyx extending to the surface (Fig. 7).

There were several small stones in the dilated calyces and a large branching one occupying most of the pelvis. Stone 2. Its middle portion was roughly granular and dark brown on one side, but the rest of its surface was smooth and sand colored. The lining of the pelvis was thickened and grayish-red in color. A small, short pedicle was observed to run

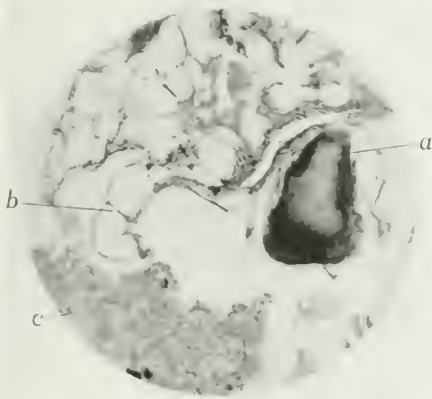


FIG. 8. Case I. Photograph of specimen of stone and portion of kidney. *a* is stone composed of crystals from dissolving capillary and *b* is trabecula of newly formed bone.

from the side of the pelvis and to be attached to the middle portion of the stone at the margin of the dark surface. It was cut and the stone removed. It was then observed that pelvic lining coming in contact with the middle portion of the stone was lightly granular, and microscopic examination of an excised portion showed ulceration, round-cell infiltration and absence of epithelial covering. The pedicle of the stone sprang from this eroded surface.

A roentgenogram of the stone (Fig. 8) showed a superficially located area of slight density about the size of a wheat grain at the point of entrance of the pedicle. Suspecting that there might be bone filling out this area of slight density, I gouged out its contents and had them sectioned after twelve hours of decalcification in five per cent. nitric acid. Microscopic examination showed spongy bone with fibrous tissue, bone marrow and capillaries filling its cancellous spaces. Small portions of stone were also present, some of which were attached to the bone, showing the undisturbed line of junction. The attached fragments appeared to be composed of oxalate, phosphate and carbonate of lime. The stone was being absorbed by fibroblasts in a rich capillary network and directly replaced by bone (Fig. 9). The stone was then broken and its middle portion found to consist of a hard, dark brown, slightly laminated, irregularly spherical mass,

which came to the surface on one side. Deposited on this was a sand colored, soft material which formed the two large, irregular poles. The pedicle had entered at a point where there was only a very thin sandy deposit on the dark central mass. The pocket occupied by bone was mainly in the peripheral part of the dark portion. The central nucleus of this area, which was the primary deposit, was some distance away from the bottom of the pocket, so that the bone could



FIG. 6.—Case II. Röntgenogram showing stones but no discernible ossified areas.

scarcely be regarded as the nucleus or starting-point of the stone. Chemical analysis of the dark portion gave calcium phosphate 10.17 per cent., calcium carbonate 10.57 per cent. and calcium oxalate 79.26 per cent. The sand colored portion gave calcium phosphate 86.35 per cent., calcium carbonate 3.57 per cent. and calcium oxalate 10.08 per cent. Both portions contained traces of magnesium and gave a negative murexide test for uric acid.

This stone gave the appearance of having been invaded by the pedicle, which sprang from pelvic wall devoid of epithelial lining and had made a pocket in the periphery of the portion composed mainly of calcium oxalate. Bone had formed in the pocket as the stone was gradually absorbed.

On the inner wall of the sacculum in the cortex of the middle portion of the kidney, there was a flat mushroom-shaped stone about 1 cm. in diameter, attached by a short, broad pedicle. Stone 3. A section for microscopic examination was cut through the stone and pedicle, including 1 cm. of the wall of the sacculum to either side. The pedicle consisted of a broad fibrous elevation of the

OSSIFICATION IN KIDNEY STONES

wall and was capped by a layer of stone (Fig. 10). The line of junction of stone and bone was distinct. The stone was of a uniform light brown color and was not laminated. To facilitate decalcification, the stone was broken away, leaving only a thin, irregular layer attached to the pedicle. Microscopic examination of the section showed the wall of the saccule away from the pedicle to be composed almost entirely of fibrous tissue. The inner lining was formed by inflammatory tissue, consisting mainly of round cells with a few lymphocytes and plasma cells. There were no epithelial cells present. The pedicle was composed of mature connective tissue in its outer portion. Its inner portion consisted of connective tissue showing some degeneration, in which there was a heavy deposit of lime salts, which increased somewhat in amount as the junction with the stone was approached. The morphology of this deposit was similar to that of calcified areas found elsewhere in the body (Fig. 11). They have been found to consist of approximately 85 per cent of calcium phosphate and 15 per cent of calcium carbonate, and that is probably the composition of this deposit.

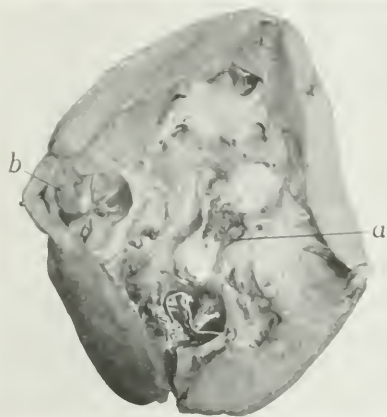


FIG. 11. Section 14. Pedicle of stone, showing the heavy deposit of lime salts in the inner portion of the pedicle, and the lighter, more fibrous tissue in the outer portion.

At the junction of pedicle and stone there are numerous small islands of bone, which have been laid down in the calcified areas. This is quite similar to the ossification which is seen in calcified areas in other parts of the body. The attached portions of stone are seen under the high power to be composed of layers made up of thread-like framework in which are deposited small granules and amorphous masses, which are lime salts, not easily identified, but presumed to be largely calcium phosphate and oxalate (Fig. 12). Chemical analysis showed the inorganic constituents to be calcium phosphate 86.39 per cent, and calcium oxalate 13.61 per cent. There was no calcium carbonate, and the murexide test for urates was negative.

This is the youngest stone of the three and shows the very beginning of the process of ossification in its pedicle. There is marked calcification in the pedicle, but all of the spicules of bone seem to have formed in the base of the stone, where connective tissue and blood-vessels have invaded it from the pedicle. It seems probable in this case that calcification occurred first in the wall of the sac, which was followed by the deposition of stone upon its free surface, and this in turn by ossification in the base of the stone.

There is a great deal of resemblance between bone, calcified areas and urinary stone. All three are composed of a crystalloid substance or substances deposited in an organic and mainly colloidal framework. Bone consists of lime salts deposited in a definitely constructed living connective-tissue

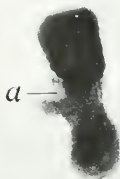


FIG. 8.—Case II. Röntgenogram of large stone, showing slight density at (a), corresponding to point at which bone was found.

framework. The proportions of lime salts and framework remain constant, being 60 and 40 per cent., respectively. Calcified areas consist of lime salts deposited in a framework of almost any degenerating or degenerated tissue of the body, and there is no definite relation between the amounts of each. The lime salts are the same in both calcification and ossification, consisting of calcium phosphate and calcium carbonate in the almost constant proportions of 85 per cent. for the former and 15 per cent. for the latter. The composition of urinary stones is more variable in every respect than that of bone or calcified areas. Crystalloid and colloidal deposits may be composed of one or more of a number of substances, any of which may vary greatly in amount. The crystalloid deposits may be organic, as uric acid, urates, calcium oxalate, cystin or xanthin, or inorganic, comprising chiefly the carbonates and phosphates. Those comprising the three mixed stones in which ossification occurred were calcium oxalate, calcium phosphate and calcium carbonate. The framework of stones consists mainly of urochrome (held not to be a colloid by Lichtwitz⁷ and others), nucleic acid and chondroitin sulphuric acid. The chemical nature of the framework in these stones was not determined.

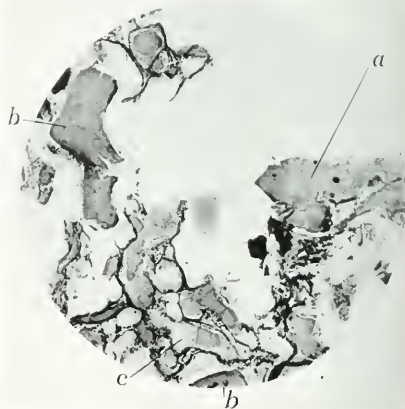


FIG. 9.—Case II. Large stone. Photograph at junction of stone and bone, showing calcified areas (a) being absorbed and replaced by bone (b). Capillaries numerous (c).

The question arises if there is a common factor in the urinary tract which influences the three processes, ossification, calcification and stone for-

mation. It is the general belief that both ossification and calcification occur normally in tissues that have an excess of acid present. The two stones here found to contain a considerable amount of bone were composed very largely of calcium oxalate, and calcium stones form in acid urine. In the large stone of Case II, consisting of a primary oxalate portion and a secondary phosphate and carbonate portion, all of the bone was in the oxalate portion, suggesting that it began to form while the urine was acid. The second phosphate deposit was added after the urine became alkaline. Since the urine is mildly acid, due to the presence of acid sodium phosphate, and bathes the field along the urinary channel in which these processes start, it should be considered as a possible causative factor.

Strauss attributed the ossification in fascial flaps, used to reconstruct the ureter in dogs, to the direct action of the acid urine upon the fascia. Neuhof considered the calcification and subsequent ossification in the fascial transplant into the bladder to be in the nature of a functional response to strengthen the weakened portion of wall. He thought the lime salts came from the urine and were deposited in the degenerating fascia. Their presence in turn stimulated the surviving elements of the graft to change into bone, which is the most powerful barrier. Dr. Howard Dabbs and I repeated Neuhof's experiments on dogs and substantiated



FIG. 1. Case II. Drawing of small kidney stone.

his findings, but we have interpreted the calcification and ossification differently. Dogs' urine is acid. The rabbit, which has alkaline urine, was used by us in four experiments, and the animals were killed in from ten to forty days. Calcification and ossification failed to occur in any of them. The sheep, which also has alkaline urine, was used in a seven weeks' experiment, and bone failed to form. We attempted to keep the urine continuously alkaline in a number of dogs with fascial transplantation into the bladder, by means of diet and administration of alkalis, but found it impossible of achievement. Bone formed in the transplant in every experiment, despite the fact that the urine was alkaline for certain periods of each day. These observations support the view that the acid reaction of the urine has something to do with the bone formation. As previously stated, all calcified areas have been found to contain about 85 per cent. of calcium phosphate and 15 per cent. of calcium carbonate, which represents their relative solubility in the blood, and precipitation of salts from a solvent occurs according to their relative solubility. The salts are carried in the blood mainly in colloidal solution and they are found in the urine in a different proportion than in the blood, the

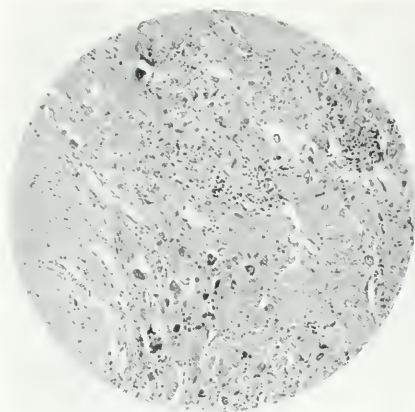


FIG. 11.—Case II. Photomicrograph. Calcification in pedicle of small stone.

Following pathogenesis: Oxalate stone 1 and the primary oxalate portion of stone 2 formed in acid urine. They grew to a size where they became fixed in the pelvis. Their roughly granular surfaces produced pressure erosion of pelvic epithelial lining. Connective tissue grew out and invaded a pocket of the stone. The lime salts of the stone and the acid reaction of the urine with which the invading pedicle came in contact produced metaplasia into bone with resultant osseous metamorphosis in the calculus. No calcification was seen in the invading connective tissue of these stones. After infection and alkalinization of the pelvic urine in Case II there was secondary stone formation, consisting mainly of calcium phosphate being relatively much lower. Therefore it seems logical to assume that the lime salts are deposited from the lymph or blood in the portion of transplant bordering on the lumen, where nutritional conditions are poorest, necrosis is greatest, and acidity increased by contact with the acid urine of the bladder. Ossification follows as a sequence to the calcification, and is also augmented by the urine.

The findings in stones 1 and 2 suggest the following: The primary oxalate portion of stone 2 suggest the following:

Their roughly granular surfaces produced pressure erosion of pelvic epithelial lining. Connective tissue grew out and invaded a pocket of the stone. The lime salts of the stone and the acid reaction of the urine with which the invading pedicle came in contact produced metaplasia into bone with resultant osseous metamorphosis in the calculus. No calcification was seen in the invading connective tissue of these stones. After infection and alkalinization of the pelvic urine in Case II there was secondary stone formation, consisting mainly of calcium phosphate

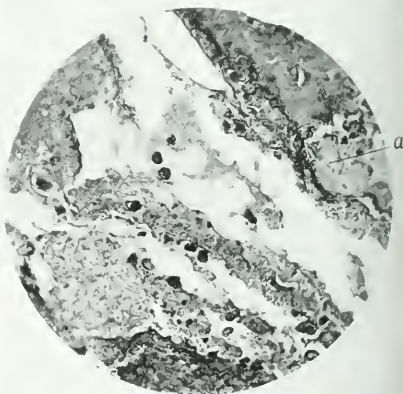


FIG. 12.—Case II. High-power of base of stone, showing framework and calcium deposits with invasion of bony trabecula (a).

OSSIFICATION IN KIDNEY STONES

The findings in stone 3 suggests a different process of development and to some extent contradict that given for the first two. The sacculization apparently occurred first, and calcification took place in a portion of the wall devoid of epithelium. Lime salts from the urine were then deposited on it in the nature of an incrustation, such as is seen upon a non-absorbable suture or other foreign body projecting into the urinary tract. A small amount of ossification took place in the base of the stone, where it joined the partially calcified pedicle. Condition easily overlooked.

I am indebted to Miss Mary E. Mavee of the Sprague Foundation, University of Chicago, for the chemical analyses of the stones.

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THE OPERATION OF CHOICE IN THE SURGERY OF THE KIDNEY*

BY WILLIAM E. LOWER, M.D.

OF CLEVELAND, OHIO

IN considering operations upon the kidneys there is one point of paramount importance which must be borne in mind and that is, that we are dealing with organs whose function is absolutely essential to life. The choice of operative procedure, therefore, cannot be governed by considerations which may govern the surgical treatment of other paired organs or of diseases of the gall-bladder, of the appendix or even of the genital organs. Whatever may be the final decision as to the function of the gall-bladder, for example, or as to the part played in the body economy by the secretions of the ovaries or the testicles, the fact remains that these organs can be dispensed with and that life can proceed with more than a fair efficiency. Fortunately there are two kidneys, and if one is permanently impaired or removed, the other can by certain compensatory changes take care of its increased load.

The essential character of the kidneys, therefore, makes the following the outstanding considerations which must be met in considering any surgical procedures upon them:

1. To establish definitely the presence or absence of a second kidney.
2. If one organ is impaired, to determine the functional capacity of the other.
3. If both organs are impaired, to determine whether or not the impairment of one is of a sufficiently minor degree to allow it to undertake the whole functional load.
4. If both are impaired, to determine whether or not the impairment of both is so slight, that first one and then the other may be repaired.

It should be borne in mind always that no operation upon the kidney should be considered a minor operation. Even pyelotomy for the removal of a stone, unless the stone lies with comparative freedom entirely within the pelvis, may be followed by the injury of the calyces and adjacent kidney tissue to such an extent as to diminish seriously the functional capacity of that kidney.

The outstanding conditions for which surgical procedures upon the kidneys may be demanded are tumors—which are almost always malignant; stones; infections—among which tuberculosis presents a particularly interesting problem; pyonephrosis; and hydronephrosis. In each of these conditions, except in the cases of those stones which, as is noted above, may be readily removed by means of a pyelotomy, a choice between a nephrotomy and a nephrectomy must be made. Before considering these various conditions in

* Read before the American Surgical Association, June 1, 1923.

detail, it is hardly necessary to emphasize the point that in every case the functional capacity of both the diseased and of the supposedly intact kidney must be rigidly determined. Some surgeons believe that if the kidney will function up to 35 per cent. of its normal capacity without liability of metastatic influence on other structures, it should be saved. Also it should be emphasized that in the determination of the identity of the suspected abnormality every diagnostic measure at our command—blood chemistry, dye excretion, röntgenograms, and urinographs—must be utilized.

The following comments regarding the operation of choice for the various pathological conditions included in this discussion are based upon my personal experience in 628 cases of surgical diseases of the kidney and 304 operations.

Tumors.—As I have noted above, tumors of the kidney are nearly always malignant. Even a papilloma which may appear frankly benign may be followed by a malignant recurrence. In the case of a tumor of the kidney, therefore, provided there is a second kidney and that kidney possesses good or fair functional capacity, nephrectomy should be performed, and if the tumor originated in the pelvis of the kidney the ureter on that side should be removed also.

In performing a nephrectomy for tumors of the kidney, as in all cases of malignancy, there should be as wide a resection of the tissue as possible, including the fatty capsule, and in most of the cases the operation should be followed by deep X-ray therapy. In some cases of sarcoma, it is remarkable how rapidly the tumor will diminish in size after the use of X-ray and radium, but I have never seen one of these cases cured in this way. Although in a large percentage of the cases there is a recurrence following operations, nevertheless there are a sufficiently large number of recoveries to warrant the opinion that surgical removal is the method of choice.

Stones.—The question as to what should be the procedure in cases of stone in the kidney or ureter has been under vigorous discussion for a long time. The cystoscope and ureteral catheter have made it possible to remove a fair per cent. of stones situated in the ureter by manipulation, but such attempts have been of little avail in the removal of stones in the kidney. Because a certain group of skilled manipulators have been fairly successful in removing stones from the ureter by means other than the open operation, advocacy of this method has led to an unwarranted effort on the part of many less skilled operators and much damage has been done with no corresponding benefit.

Having decided that an open operation is the method of choice in the removal of a stone in the kidney, what type of operation should be performed? Both clinical and experimental researches have shown that nephrolithotomy is attended by a higher mortality rate and a greater loss of function than pyelolithotomy. In only the exceptional case need the kidney be completely divided for the removal of a stone. A free opening of the kidney pelvis, extending the incision up into the cortical substance if necessary, as recently shown by Eisendrath, will permit the removal of a large branching stone with

little or no hemorrhage and a minimum destruction of kidney substance. In the occasional case it may be easier to remove an imbedded stone by a localized incision or puncture in the kidney, directly over the stone, but the bi-section of the kidney is a destructive operation which should be abandoned. The use of the fluoroscope as recommended by Braasch and Carman for the determination of the location of fragments or small stones is novel and has undoubted merit. When this cannot be done, the taking of a film with the kidney exposed as suggested by Quinby is another method of determining whether there are any remaining fragments. Irrigating the pelvis and calyces with syringe and catheter when the pelvis is opened will often remove small fragments which might be difficult to find by manipulation.

When stones are present in both kidneys the decision as to the method of intervention becomes more difficult. The location and not the relative size of the stones may be the determining factor as to which side should be operated upon first. A stone obstructing the ureter will more definitely impair the kidney function than will a large branching calculus which although it may fill the kidney pelvis and calyces, yet does not definitely obstruct the ureter. Cases of bilateral stones should practically always be operated upon, for although patients may live for many years with large stones in both kidneys, the stones will eventually destroy life if allowed to remain and a careful preparation and operation is not necessarily attended with a high mortality. The prevention of the recurrence of stones in the kidney presents a more difficult problem than their treatment.

Infections.—In cases of infection of the kidney it is not always easy to decide whether or not to operate. The presence of tubercle bacilli in the urine, especially if unilateral used to be and still is with many a sufficient criterion for operation. I do not believe so radical a stand should be taken. If there is a definitely localized tuberculosis on one side with abscess formation, there is no question as to the method of procedure and we all know the happy results obtained in these cases. But in those cases in which the only lesions found at operation are small tubercles, mostly beneath the capsule, with no definite walling off, operation often results only in a rapid lighting up of a general miliary tuberculosis and a speedy dissolution. The problem in such cases is, primarily, one of diagnosis, and I am convinced that if a correct diagnosis can be made by waiting, it is far better to wait than to operate upon some of these cases too early. I believe that we shall be able to work out a method whereby an accurate diagnosis can be made before operation is instituted.

If operation is decided upon, nephrectomy is, of course, the operation of choice. Even in cases of bilateral tuberculosis the removal of the more extensively involved organ will alleviate the symptoms. In cases of tuberculosis, however, operation is but one step in the course of treatment. The post-operative management of the case and the use of general hygienic measures play an important part in obtaining the best results.

In those cases of infection which are metastatic in origin, it is difficult

to decide what type of operation should be performed, if, indeed, one should operate at all. Personally, I do not operate on the so-called multiple septic infarct cases at once. Often these cases, even with very high temperatures and with involvement of both kidneys, will recover without surgical intervention. If well-defined localized abscesses develop, however, and the other kidney remains free, a nephrectomy should be performed.

Hydronephrosis presents a most interesting problem. Before Hinman performed his important researches in connection with this condition, we felt that it was sufficient to remove the cause of the ureteral obstruction whatever it might be in order to restore the function of the kidney. We now know, however, that in these cases the opposite kidney has hypertrophied and compensation has taken place. Removal of the obstruction does not restore to the kidney its functioning power so that instead of a working organ we still have, in many cases, only a large sac with little functioning substance. If infection is present, this sac is a definite menace to the other kidney, which is already doing the work of both. Therefore, instead of simply removing the cause of the obstruction, if it has existed for any length of time, the only safe procedure is to perform a nephrectomy.

It will be noted in the above discussion that we would appear to be favoring nephrectomy almost to the exclusion of nephrotomy and it is true that we are coming increasingly to adopt the point of view that provided one functioning kidney remains the dangers of nephrotomy are not justified. These dangers are briefly as follows: persistent hemorrhage; failure of the wound to close with the consequent leaving of a constantly infected urinary fistula; permanent damage to the kidney structure by contracting scar tissue; diminished resistance of the kidney operated upon; the increased danger of the recurrence of pathological conditions whether stone, infection or tumor; and finally the inevitable effect of a prolonged suppuration of one kidney upon its fellow.

Since the purpose of this paper is simply to present certain principles underlying the choice of operation, I have made no attempt to give detailed descriptions of the technic of the various operations.

CONCLUSIONS

No inclusive statement can be made regarding the operative management for any type of kidney lesion. All the factors in the individual case must be considered in making a decision as to the proper operative procedure. If the proper pre-operative precautions be taken and a careful choice of operation be made, the mortality rate of operations on the kidney will not be high. In my own series the mortality rate has been 1.7 per cent.

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CARCINOMA OF THE BLADDER *

By JOHN B. DEEVER, M.D.

AND

WILLIAM H. MACKINNEY, M.D.

OF PHILADELPHIA, PA.

THIS contribution to the study of carcinoma of the bladder is based upon the analysis of 131 cases occurring in our experience since 1910.

Of these 131 cases, 107, or 81 per cent., occurred in the male, and 24, or 19 per cent., in the female, a ratio of approximately four males to one female.

An analysis of the age at which these cases occurred, may be gleaned from the appended chart, showing that while carcinoma occurs at practically every age in adult life, it is most common in the fourth, fifth and sixth decades, during which periods 100 of our cases occurred. The average age in the total number of cases was 54.2 years. The statement has been made that carcinoma of the bladder is more commonly met with at an earlier age than carcinoma of other portions of the body. In our cases, however, the average age is about the same as carcinoma situated elsewhere.

Interrogation of the patients led to the discovery of a family history of carcinoma in 16, or 12.2 per cent. of the patients. Two patients with carcinoma of the bladder had previously been operated for carcinoma of the breast, and in one case the wife of the patient had been operated upon for carcinoma of the uterus.

Six of the 131 cases had had an operation for tumor of the bladder prior to coming under our observation. These cases are of special interest because of the long interval between operation and the date of recurrence. One case was operated upon twenty-one years before recurrence, one case nine years, one case six years, one case five years, and two cases four years; thus proving that no time limit of cure can be estimated in dealing with carcinoma of the bladder.

The diagnosis of carcinoma of the bladder was based upon: First: The microscopic examination of specimens removed by operation. Second: The microscopic examination of pieces of tumor removed by forceps or passed by the patient. Third: Cystoscopic examination. Microscopically, the evidences of malignancy vary within wide ranges, from the early degeneration of the epithelial covering of what might cystoscopically be judged benign papilloma, to the advanced carcinomatous papilloma, and finally the infiltrating squamous-cell carcinoma. This last type constitutes the most malignant carcinoma of the bladder, excepting the adenocarcinoma which has not been encountered among these cases examined microscopically. Correlating the clinical and microscopic findings, we have come to the conclusion that a truly benign tumor of the bladder is rarely encountered and that tumors of medium or large size, invariably show microscopic evidence of malignancy.

* Read before the American Surgical Association, May 31, 1923.

A review of the symptomatology of bladder tumor adds nothing of interest except to emphasize the lamented fact, recognized by every surgeon and urologist, that hæmaturia, the cardinal symptom of tumor, is disregarded as a symptom of serious import by the physician, and that procrastination takes the place of the cystoscope.

In only 21 cases was a cystoscopic examination made before three months of hæmaturia, and in 35 a period of from three months to one year had elapsed. In 48 cases a history of bleeding for over one year was elicited, and in 26 of these a history of hæmaturia for more than two years. It is indeed surprising how long a tumor of the bladder may exist and give rise to periodic bleeding and yet for many years have no apparent effect upon the general health of the patient. This would indicate that a large percentage of vesical neoplasms show a low degree of malignancy, and this, coupled with the fact that these tumors do not show a tendency to early metastasis, should place carcinoma of the bladder in a particularly favorable field for early curative surgery.

Pain is not a pronounced symptom of the tumor, and when it occurs it is usually late in the disease. Symptoms of cystitis, frequent, urgent urination with pus and blood in the urine is often a complication of carcinoma, in contrast with benign tumors which are rarely so complicated.

From a cystoscopic standpoint it is usually not difficult to make a diagnosis of tumor of the bladder since few pathologic conditions simulate it. Syphilis of the bladder gives rise to a nodular infiltration of the wall of the bladder, which may ulcerate and simulate carcinoma. It is impossible to differentiate the condition, and a positive Wassermann test should be followed by an active therapeutic test before surgery is advised. Some types of ulcerative cystitis, particularly a variety occurring in diabetes, of which we have seen two examples, resemble in appearance an ulcerative carcinoma. Fortunately, routine urine examination detects the presence of sugar, and under proper diabetic régime the cystitis subsides.

Tuberculosis of the bladder rarely simulates tumor, particularly when manifested in the form of tuberculoma.

While the diagnosis of neoplasm is usually easy, it is not always possible to differentiate the truly benign tumor from the early malignant one. Microscopic examination of pieces of apparently benign growths show epithelial changes of varying degrees, all indicative of malignancy, and these changes have so frequently been reported in cases of cystoscopically benign neoplasms, that we are led to believe that a truly benign tumor of the bladder is a rare occurrence. This is, furthermore, borne out from a clinical standpoint by the frequency of recurrences under any form of treatment, and by the fact that microscopic examination of these recurrent tumors, may show malignant changes undiscovered by the microscopic examination of the primary tumor.

Cystoscopically the characteristics of papillary carcinoma of the bladder are: Shortening or absence of the villous projection, evident ulceration of the tumor surface, an impression of density and an infiltration at the site of attach-

ment with a broad sessile base. In more advanced papillary carcinoma the bladder wall at the site of the tumor is infiltrated and cedematous while the remaining bladder mucosa is inflamed. Cystitis rarely accompanies a benign growth, so that the presence of a cystitis complicating a tumor is evidence of malignancy. Multiplicity of tumors is usually, but not always, indicative of malignancy, and large tumors likewise are practically always microscopically malignant. The cystoscopic diagnosis of infiltrating carcinoma of the squamous-cell type is based upon the presence of a tumor involving variable extents of the bladder wall, rarely exceeding a silver dollar in size, with a flat, rough ulcerated and bleeding surface, devoid of villous projection and fading off into the surrounding bladder wall, with no definite line of demarcation. It is frequently accompanied by marked cystitis. The size of a papillary carcinoma is limited only by the capacity of the bladder; squamous-cell and the more rare adenocarcinoma of the bladder infiltrate definite areas of the bladder wall, and commonly there is but one tumor present.

Various cystoscopic instruments and forceps have been devised to remove portions of a vesical tumor for treatment or for diagnostic purposes. The most satisfactory of these is the cystoscopic rongeur, with which a good sized portion of the tumor may be broken off and removed for examination. This was done in 23 of our cases in order to establish the diagnosis. Experience, however, with this method has led us to conclude that it is unnecessary and for the most part inadvisable. We have found that the removal of a portion of the tumor is not infrequently followed by considerable hemorrhage, and that retention of large clots in the bladder causes considerable trouble, necessitating their aspiration or an emergency suprapubic cystostomy. Furthermore in all cases where this procedure is used there is the possibility of opening up channels for the extension or the transportation of tumor cells. For these reasons we have practically discontinued the cystoscopic removal of portions of tumors for diagnostic purposes, preferring rather to rely upon the cystoscopic appearance of the growth in advising the method of treatment.

An analysis of our 131 cases shows that 10 cases received an opinion in which operation was advised, but as far as known the advice was not followed; 46 were declared to be inoperable because of the size and extent of the carcinoma and the general poor condition of the patient. Forty-two cases were operated upon by suprapubic cystotomy and the tumor dealt with in various ways, and 33 cases were treated primarily by endo-urethral fulguration.

In four of the 43 cases the bladder was opened and drained to meet the emergencies of retention of urine and excessive bleeding. No attempt was made to remove or destroy the tumor. One of these patients is alive; he has been wearing a permanent suprapubic drainage apparatus for a period of eighteen months and is able to pursue his usual occupation. Twenty-two cases were operated upon by excision of the tumor from the mucous membrane base, and in five of these the wound in the mucous membrane was repaired by catgut suture, while in 17 the base was cauterized with the

Paquelin cautery. In 7 cases the tumor was so situated as to allow a resection of the bladder wall with the attached tumor, without necessitating transplantation of either ureter.

Radium alone was implanted in one case, and in eight the tumor was thoroughly destroyed by the D'Arsonval current, followed by 1000 to 1500 milligram hours of radium applied in needles. In 33 cases the tumor was treated by endoscopic fulguration, using the Oudin current and supplemented in two cases by radium introduced per urethram.

It has been impossible, unfortunately, to trace the results of all the cases treated.

Of the 5 cases treated by excision of the mucous membrane and suture of the base with catgut suture, three have remained well and free from recurrences eighteen months, two years and two and a half years, respectively. One case had a severe post-operative hemorrhage twelve hours after excision, necessitating re-opening the bladder and using the cautery to control the hemorrhage. One case left the hospital presumably well, but never returned for observation. These cases were all of the papillary variety with definite and small pedicles easily removed by excision with subsequent suture of the denuded mucous membrane. This group is a very small one, but as far as is known, no recurrences followed and there was no mortality. In the 17 cases in which the tumor was excised and the base cauterized, 5 were examined six months, nine months (2), one year and four months after operation and found normal; 7 cases never returned for examination after discharge and 3 suffered recurrences, two in three months and one in four years. One case died in two months and one in one year, the tumor persisting after operation.

In the 7 cases of resection, three patients remained well, one, two and two and a half years respectively. One died in four months, and three have suffered recurrences, two in two years, and one in two years and three months. Cystoscopic fulguration has been applied in the treatment of these recurrences with varying degrees of success. In six cases, four have been successfully controlled over periods of from three to eleven years by examinations at intervals of from three to six months in each case; in two the recurrence failed to respond and operation being rejected, death ensued in seven months and three months, respectively.

Of eight cases treated by suprapubic cystostomy, high frequency destruction of the tumor with the D'Arsonval current and the implantation of radium, five were of the infiltrating type of carcinoma and three of the papillary type. Of the five cases of infiltrating carcinoma, one died in six days, and three within six months, all suffering complete invalidism from the date of operation to the time of death. One case of squamous-cell carcinoma has remained well three years. In three cases of papillary carcinoma so treated, one died in two weeks and two cases are reported well, one of them one year and seven months and the other two years and three months.

In one case in which radium was implanted without fulguration, death ensued in three months.

All 31 cases treated primarily by cystoscopic fulguration with the Oudin current were of the papillary carcinomatous type, many of them showing but slight epithelial evidence of malignancy; others, definitely malignant were advised to have a radical operation, but refused and were therefore treated in this manner. It is safe to say at the outset in discussing this group, that where definite cystoscopic evidence of malignancy exists, fulguration is usually not successful in the presence of an active cystitis, even when the treatment is facilitated in such cases by general anesthesia. Occasionally one is surprised by an unexpected response to cystoscopic fulguration of a definitely malignant tumor; this, however, is exceptional. Of the 31 cases treated in this manner, four failed to respond to treatment and died in from six months to seventeen months; 13 were followed for periods of from three to ten years; in 3 of them recurrences were the cause of the return of symptoms after an interval of apparent cure of five, five and eight years, respectively. Of the 14 remaining cases, 4 were observed for one year, and 10 failed to report after intervals of three to nine months following an apparent cure.

A pathological examination was secured in 23 cases, using tissue which removed by cystoscopic forceps or rongeur, or occasionally passed by the patient, on which to base a diagnosis. It is from the study of these specimens that we have come to the conclusion that truly benign tumors of the bladder are rare. Two cases received intravesical applications of radium per urethram in addition to fulguration. No response to treatment was obtained in one case, death ensuing in eighteen months; the other has been an invalid for seven years but is probably cured of his cancer.

Summarizing the salient facts regarding carcinoma of the bladder as deduced from our experience, we are able to say that:

1. Carcinoma of the bladder occurs from three to four times more frequently in males than in females.
2. A family history of carcinoma was elicited in 12.2 per cent. of our cases.
3. Transient, symptomless hæmaturia is, as a rule, the first and frequently the only symptom of bladder tumor.
4. Such hæmaturia demands cystoscopic investigation; watchful waiting spells disaster.
5. A patient may live for a long time with a true carcinoma of the bladder, indicating a low degree of malignancy, and this, coupled with the recognized infrequency of metastasis, should place carcinoma of the bladder in a particularly favorable field.
6. Papillary carcinoma is ten times more frequent than infiltrating squamous-cell carcinoma.
7. Only in two-thirds of the carcinomas of the bladder encountered was any form of treatment justified. This is due to procrastination in diagnosis.
8. Practically all tumors of the bladder are malignant.

9. Cystoscopic fulguration is the best treatment of small or medium-sized single pedunculated carcinomas, uncomplicated with cystitis. It has little place in the treatment of semi-solid, sessile papillomas, and no place at all in the treatment of advanced papillary tumors or of infiltrating or squamous-cell carcinoma.

10. A choice of operative method in the treatment of carcinoma, here, as elsewhere, depends upon the situation of the tumor. Resection of the bladder with the tumor attached, where such can be accomplished without necessitating transplantation of the ureters, appears to us as the method of choice. Where resection cannot be done, excision with the cautery, or high-frequency destruction, is the next best procedure. The mortality of extensive resection with transplantation of one ureter, or total extirpation of the bladder with transplantation of both ureters, is extremely high, and is practically never justifiable. Radium has accomplished little in the cure of carcinoma of the bladder and has probably hastened a fatal termination in many cases in which it has been employed.

PATHOLOGICAL CHANGES, OCCURRING IN THE SPINAL CORD, FOLLOWING FRACTURE DISLOCATION OF THE VERTEBRÆ*

BY JAMES E. THOMPSON, B.S., LON., F.R.C.S., ENG.

OF GALVESTON, TEXAS

IN the following communication I shall try to describe simply and accurately the pathological changes, immediate and remote, that occur in the spinal cord when it is crushed by the displaced vertebræ in the condition known as fracture-dislocation.

Any consideration of direct wounds of the cord caused by penetrating bullets or shell fragments will be purposely omitted because these injuries stand in a class by themselves, in that they are compound fractures, and as such are liable to septic infection. Although infection is a rare complication in through-and-through bullet wounds, it often occurs in the ragged wounds produced by sharp pieces of shell, especially if the missile is retained in the spinal canal or carries in with it a piece of clothing. Apart from any consideration of the nervous injury, such wounds must be operated on to prevent death from septic infection, the object of the operation being solely the removal of the foreign body and the cleansing of the wound.

In crushes of the cord resulting from fracture-dislocation the nature of the injury is entirely different. There is no external wound and no danger of septic infection. Although the cord is often severely damaged by being pinched by the displaced vertebræ, the pressure is usually relieved by the recoil of the bones when the displacing force ceases to act. When the recoil is complete the damaged cord lies in the canal, which is not narrowed or distorted, but is as roomy as it was before the injury. On this account operation is seldom advisable or justifiable.

Fracture-dislocations of the spine may occur from direct or indirect violence. Those caused by *direct violence* may follow an injury acting in a horizontal plane such as a direct blow or kick or a sidewise impact caused by a fall. If the point of impact is concentrated on a spinous process it may fracture it or drive it inwards together with the laminae against the cord, producing immediate symptoms of cord injury. If the spinous process and laminae are strong and rigid the vertebra may be driven directly forwards and dislocated. As a rule the displaced vertebra retains its connection with the vertebra above, and the displacement forwards affects the whole of the upper part of the spine. The inter-vertebral disc between it and the body of

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the vertebra below is torn or portions of the bodies of both vertebræ are broken off obliquely. This may occur without fracture of the neural arch, or in the cervical region without even fracture of the articular processes, although the latter rarely escape injury. The cord is frequently crushed severely between the laminae of the displaced vertebra and the body of the vertebra below.

Fracture-dislocations by *indirect violence* are caused by the application of a force at a distance from the lesion. Thus, a fall on the head will usually fracture the cervical spine, and a fall of a heavy weight on the nape of the neck will frequently fracture the thoracic vertebræ. Force acting downwards along the thoracic spine or upwards along the lumbar spine will frequently fracture the vertebræ at the thoraco-lumbar junction. The line of separation is usually through the intervertebral disc, but in addition the anterior surface of the bodies of the vertebræ may be chipped off obliquely and the articular and spinous processes broken irregularly. The vertebra above the lesion carrying the whole spine with it is displaced forwards and downwards on the vertebra below. If the displacement is great enough the spinal cord is crushed between the lamina of the vertebra above and the posterior upper edge of the vertebra below. As a rule the displacement persists as long as the force continues to act. As soon as the spine is straightened the deformity disappears because the vertebræ recoil to the normal position. In some cases, usually in the cervical region and particularly where the articular processes of the vertebræ are not fractured, *i.e.*, in cases which are, strictly speaking, examples of a dislocation, the recoil does not occur and the resulting deformity persists. In most of these cases reposition is possible by manipulation under an anæsthetic; but some cases resist all attempts at replacement.

It is of fundamental importance to emphasize the fact that vertebral recoil is the rule and that the moment the vertebræ return to their normal position, the vertebral canal is restored to its former size. The cord is no longer subjected to pressure, and from this time on if nervous symptoms persist other factors must be held responsible.

The exact nature of these factors will be revealed by a careful study of the pathological changes in the traumatized tissues.

The Vertebrae.—Sometimes the vertebral bodies escape injury completely, the line of separation passing accurately through the intervertebral discs. This is more frequently seen in the cervical region (Figs. 1, 2 and 3). In the thoracic and lumbar regions, although the main line of separation is along the intervertebral discs the anterior surface of the body of the vertebra below the line of separation is usually chipped off obliquely. Occasionally the chipping affects the bodies of several vertebræ, including the body of the vertebræ above the line of separation. Sometimes a considerable wedge of bone is

chipped off; at others the fragments of bone are of small size. It is caused partly by the direct impact of the displaced vertebra above and partly by the pull of the anterior common ligament which is torn up bodily from the front of the bodies of several vertebrae below the line of separation. In cases that die shortly after injury extensive extravasation of blood can be seen, at autopsy, in this situation. In rare instances the bodies of the vertebrae are fissured transversely (Fig. 8). The articular processes rarely escape injury. In the cervical region, if anterior flexion of the upper vertebrae is extreme at the time of the accident, the ligamenta subflava and interspinous ligaments may be torn and the articular processes of the displaced vertebra may be carried forwards in front of the lower without breaking either one (dislocation). Usually, however, one or both articular processes are fractured. In the thoracic and lumbar regions fracture of the articular processes is the rule. In rare instances, however, when flexion of the spine is excessive they may ride over one another without breaking. In addition the displacement frequently tears up one or more spinous processes. The laminae and pedicles are rarely broken in fracture-dislocations caused by indirect violence. Where the violence is direct both laminae and pedicles are frequently fractured.

The Spinal Canal.—In cases where the recoil is complete the spinal canal is not narrowed or encroached upon in any way. Narrowing of the canal is seen only in cases of pure dislocation or fracture-dislocation where reduction is incomplete, and in cases of fracture of the laminae from direct violence where the bone has been driven inwards.

Extravasation of Blood in the Spinal Canal.—Even in cases operated on, or autopsied early or within the first week, the quantity of blood found between the bone and dura mater is very small. We have never seen an extravasation large enough to cause pressure on the cord or even to cause the dura mater to bulge towards the cord. These observations are in complete accord with those of Thorburn and others. Occasionally we have found small worm-like extravasations situated several vertebrae below the crush.

The Dura Mater.—Tears of the dura mater are rarely seen except in direct wounds. Those seen in museum specimens are usually made during the removal of the cord. During operations on recent cases in which complete recoil of the vertebrae has occurred, there is ample space between the bone and dura. In old standing cases, the dura is often very adherent to the ligamenta subflava and the laminae of the vertebra, especially when marked deformity exists. Adhesions are also frequently seen between the dura and pia in old cases where deformity persists and the cord is crushed completely (Fig. 22).

The Arachnoid.—As in the normal state the arachnoid is closely applied to the inner surface of the dura mater. In recent cases the subarachnoid space is not narrowed. There is free circulation of subarachnoid fluid across the site

of the crush. The fluid is often blood-stained, but it is rare to find it so thickly mixed with blood as we see it in some fractures of the base of the skull. Clots are rarely seen. When present they are very small and are found clinging to the surface of the crushed pia mater. We have never seen a clot large enough to produce pressure on the cord or even to fill the subarachnoid space. In old standing cases the arachnoid may adhere to the surface of the pia and interrupt completely the subarachnoid space above and below the adhesions. (Case XIII, Fig. 22.)

Pia Mater.—Except in direct wounds the pia mater is seldom torn. Although it is a thin membrane, it is very tenacious. Even in examples of complete pulping and crushing of the cord, the disintegrated nervous matter will be forced upwards and downwards along the intact pia mater, which rests in the dural sheath like a tube or sleeve of fine gauze stretching between the proximal and distal ends of the cord. In cases where the vertebral deformity persists the disintegrated nervous matter is prevented from returning into the tube of pia. Consequently at operation or autopsy a thin flattened tape-like tube of pia is seen holding together the severed ends of the cord. This condition is shown in Figs. 18 and 23. Extravasations of blood between the pia mater and the cord are usually minute in size. Most of them are the superficial outcrops of the larger foci extravasated in the depths of the cord.

Spinal Cord.—It is vitally important to visualize the structural changes that occur in the architecture of the cord and to estimate them at their true value. The primary effect of injury, whether it be a direct crush or a molecular vibration produced by a penetrating missile or by a contusion, is to destroy the ganglion cells, axis cylinders and myelin sheaths by shaking them loose from their supporting network of glial tissue, reducing them frequently to a hopeless pulp of disintegrated material, in which it is impossible to recognize the essential nervous elements, or in fact to distinguish any structure except the lacework of the neuroglia. There is of course extravasation of blood because such destructive processes cannot occur without tearing blood-vessels. The extravasations, however, are small and are confined, as a rule, to the injured zone. There is no tendency for the blood to travel into areas which have escaped injury. In recent cases the extent of the area of nervous destruction is often graphically indicated by discoloration from extravasated blood which occupies the interstices of the glial network from which the nervous elements have been squeezed by the crush. This is shown, not only in human cords removed at autopsy, but in the cords of dogs traumatized experimentally. The area and shape of the disintegrated area is very uniform when the nature of the force producing it is also uniform and focussed. Conversely it may be just as irregular when the force is applied irregularly and diffused. Thus, in crushes of the cord produced by displaced vertebræ or those produced experi-

mentally by carefully applied and graduated force the injured areas are surprisingly alike; whereas in those produced by missiles or contusions they are subject to many variations in size and shape. The crushed area is often indicated by the presence of extravasated blood which can be seen through the pia mater if it is near the surface of the cord. In many cases where the whole thickness of the cord has been crushed for an appreciable distance, a dark band or ring of extravasated blood may indicate the injured area. This is frequently seen in the cords of dogs crushed by the pulp of the experimenter's finger. Such cords often show an area of discoloration extending upwards and downwards from the bruised level, which represent the areas of destruction. These areas are cone-shaped, united at their bases, which correspond to the line of crush, and tapering upwards and downwards in the substance of the cord. Thorborn and Richardson, who first described this peculiarity, found that the lower cone was more truncated than the upper. This appearance is so constant that it suggests strongly that the mechanism of destruction is a vibratory wave which starts at the point of impact and exerts a divulsive action on the friable nervous tissue. It can be imitated very closely by crushing transversely a ripe banana in its skin with the edge of a ruler or a lead pencil. A horizontal section will show cones of bruised pulp, exactly like those seen in the spinal cord which stand out in striking contrast with the sound pulp if the fruit is kept for twelve hours.

As a rule the disintegrated area can be distinguished by its blood-stained appearance. It is probable that some degree of extravasation always accompanies disintegration. It must, however, be emphasized that massive hemorrhage and clots never occur even at the area of greatest destruction. It has appeared to us that the disintegration is more marked at the point of impact and that the cone-shaped areas of destruction occupy the centre of the cord without any particular preference for either gray or white matter. This feature will be considered later in the description of actual specimens. Apart from discoloration at the point of impact the appearance and shape of the cord may show no change. Even where its substance is completely crushed, the disintegrated material may flow back into the uninjured sleeve of pia mater and fill it up completely so that it looks as symmetrical as it did before the injury. If, however, pressure is kept up for a long period, the cord will remain narrowed permanently. We shall picture such cords later.

The foregoing remarks are founded mainly on a study of the spinal cords preserved in the pathological museum of the University of Texas. We shall now proceed to describe their pathological features. For convenience we have divided them arbitrarily into four groups. In the first group we have placed the cases of instantaneous death caused by a crush above the origin of the phrenic nerve. The second group contains the cases living a few days only; the third, a few weeks, and the fourth, a longer period.

FRACTURE DISLOCATION OF THE VERTEBRÆ

GROUP I, CASES OF INSTANTANEOUS DEATH

CASE 1.—McG. Sealy Hospital. Autopsy No. 524. The patient, age forty-two years, fell down an elevator shaft and was picked up dead. Abnormal mobility with crepitus was found in the lower cervical region.

The autopsy revealed a fracture-dislocation at the level of the intervertebral disc between the 5th and 6th cervical vertebrae. The 5th vertebra carrying the upper vertebrae with it had been displaced forwards on the 6th. The recoil, shown in Fig. 1, was practically complete and very little deformity

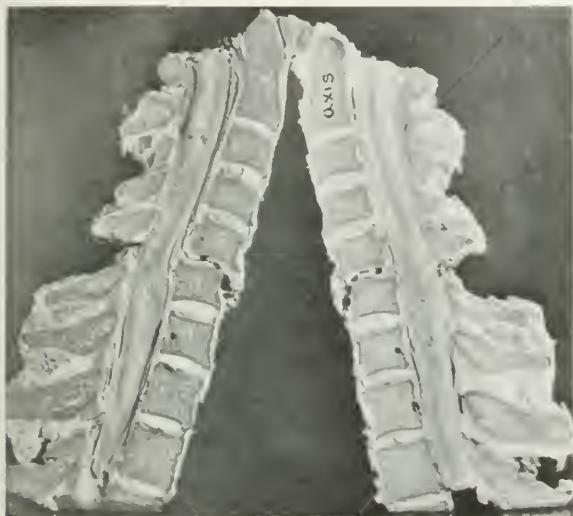


FIG. 1. Case 1. Photograph after recoil.

was present. The interspinous ligament between the 5th and 6th spines was completely torn. Evidently the spinal column had been bent acutely forwards and the 5th vertebra displaced forwards to a considerable distance crushing the cord severely. Extensive pulping of the cord tissue can be seen. It is shown by longitudinal streaks of disintegrated tissue which extend upwards as high as the middle of the 3rd cervical vertebra and as low as the upper border of the 7th. The lower area shows cavitation. There is no sign of hemorrhage either in the membrane or in the substance of the cord. Death was practically instantaneous because the crush was above the origin of the upper roots of the phrenic nerves.

A longitudinal section of the fractured spine is shown in Fig. 1. In Fig. 2 the deformity has been reproduced to show the mechanism of the fracture and the kind and degree of deformity.

No microscopic sections were made of the specimen, because it had been frozen and divided with a saw before being mounted, and we were afraid that

the nervous structures would be seriously injured and distorted by the mechanical injury.

CASE II.—J. B. Sealy Hospital. Autopsy No. 501. The patient fell down an elevator shaft and was picked up dead. There was abnormal mobility of the upper part of the neck with crepitus.

The autopsy revealed a fracture-dislocation of the cervical spine which showed some unusual features. The line of separation between the bodies of the vertebrae passed between the 2nd and 3rd cervical. The intervertebral disc was ripped

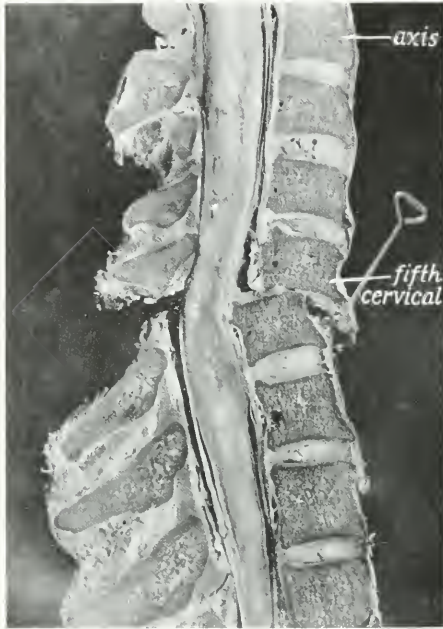


FIG. 2.—Case 1. Deformity reproduced.

up completely from its bed. It was held in contact with the displaced body of the 2nd by the anterior common ligament. Both pedicles of the arch of the axis (2nd) were broken. The interspinous ligament between the atlas and axis was torn through completely and the separation between the posterior arches of these vertebrae was so great that the dura mater could be felt by the finger. The line of separation between the vertebrae was therefore very irregular and oblique, to wit: between the bodies of the 2nd and 3rd, through the pedicles of the 2nd and between the arches of the 1st and 2nd.

There was no hemorrhage to speak of in the soft tissues

of the neck; and none at all in the extradural space. The intradural space was free from hemorrhage. The cord showed no signs of bruising. It did not appear to be compressed, nor were there any hemorrhages in its substance. A slight angular bend is shown in Fig. 3. The absence of hemorrhage is probably due to the instantaneous death. In this respect it is analogous to Case I. On account of the method of preparing the specimen, namely, freezing and sawing, no microscopic sections were made.

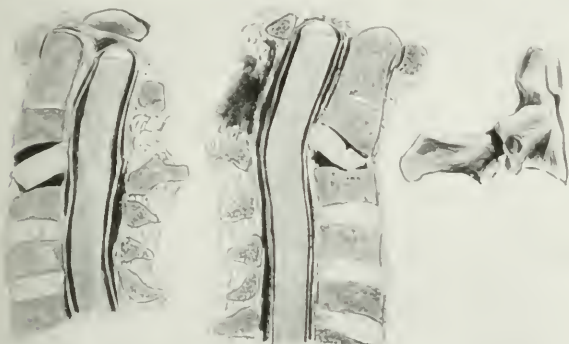
Remarks.—In both cases there are two conditions worth emphasizing, (1) the absence of hemorrhage either in the cord or the structures around it;

FRACTURE DISLOCATION OF THE VERTEBRÆ

and (2) the complete recoil of the vertebræ with restoration of the spinal canal and release of the pressure on the cord. Instantaneous death accompanied by immediate arrest of the heart's action would explain the former.

GROUP II. CASES DYING A FEW DAYS AFTER THE INJURY

CASE III—L. P. C. Hospital No. 131212. Autopsy No. 1627. The patient was admitted to the Sealy Hospital on October 16, 1922, showing symptoms of a total transverse lesion of the spinal cord associated with a fracture-dislocation



Fell from 4th floor down elevator shaft; picked up dead

FIG. 3.—Case 2. Drawing in the centre shows the deformity, that on the left the appearance after recoil.

of the spine, which had resulted from a direct crush between an elevator and the floor. He was suffering from severe shock, and consequently the examination of the motor and sensory functions was very unsatisfactory. The ulnar border of the forearm and ulnar half of the hand were insensitive, and flexion of the wrist impossible. There appeared to be complete anæsthesia and flaccid paralysis below the level of the 7th cervical segment. The patient remained in a condition of profound shock until his death, which occurred twenty-four hours after the injury.

At the autopsy a fracture-dislocation was found (Fig. 4), the line of separation passing between the bodies of the 7th cervical and 1st thoracic vertebræ. There was very little original deformity and the spinal canal was not much narrowed. A large extravasation of blood was found in front of the bodies of the vertebræ, under the anterior common ligament. It extended downwards as far as the mid-dorsal region. There was no blood in either extradural or intradural space in the neighborhood of the lesion. A very small worm-like clot was found clinging to the outer surface of the pia mater about three inches below the lesion. The cord at the level of the lesion was slightly flattened, but not disintegrated. Several small hemorrhages were seen on its outer surface. Both dura and pia mater were intact.

A section of the cord taken through the lesion is shown in Fig. 5. The cord is flattened in front, and both white and gray matter are distorted. Numerous hemorrhagic foci are seen scattered throughout the section in both white and gray matter. The gray commissure is completely hemorrhagic. A noticeable feature is the complete absence of the changes usually associated with oedema. The cord is not swollen. On the contrary it is smaller than normal, and the pia mater is wrinkled. In spite of the flattened distorted shape of the cord

the sheath of pia mater is intact everywhere. The wrinkling shows best on its posterior surface. Identical findings are shown in the dog's cord pictured in Fig. 28.

The microscopic findings do not reveal enough destruction to justify a conclusion that the conductivity of the cord was destroyed completely and permanently. It is probable that, if the patient had lived long enough, both motion and sensation would have been restored to a considerable degree.

At the autopsy, a gangrenous appendix was found. It had not perforated. The patient was feeling very sick when he started work on the morning of the accident, and the mishap was caused probably by his lack of alertness.

CASE 1 V.—R. B. Hospital No. 8799. Autopsy No. 1650. The patient was admitted to the Sealy Hospital on January 29, 1923, deeply

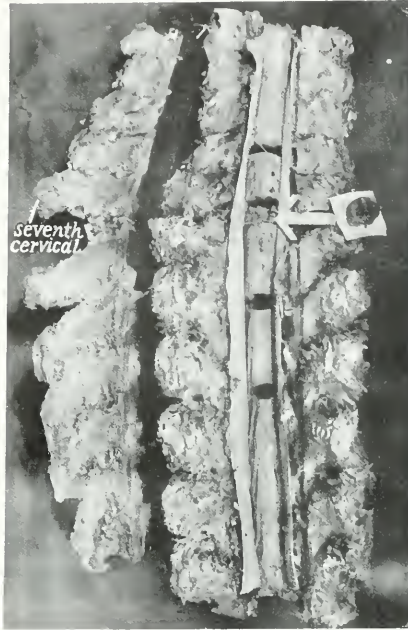


FIG. 4.—Case 3. Slight angular deformity; absence of hemorrhage in meninges; hemorrhage without marked crushing of the cord.

intoxicated with alcohol. There was a history of a fall of about 15 feet. We were unable to get accurate information as to when the accident occurred. It is probable, however, that he was hurt on the night of January 28th, the day before his admission. He died at noon on January 30th. He probably lived about 40 hours after the injury. The interne who examined his chest on the afternoon of his admission said that he was able to hold his body in a sitting posture during the examination. This statement is probably not reliable because the patient was comatose from alcohol and was supported by an orderly.

Fractured spine was suspected during the visit of the attending physician on the morning of January 30th. The patient was semi-conscious and the examination

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was unsatisfactory. There was flaccid paralysis of both lower extremities and complete anæsthesia. All the deep reflexes were absent. He was unable to move his arms. Sensation in the arms and forearms was indeterminate. He was not conscious enough to justify any conclusions. Examination of the muscle reflexes was very definite. There was well marked response in the biceps, triceps

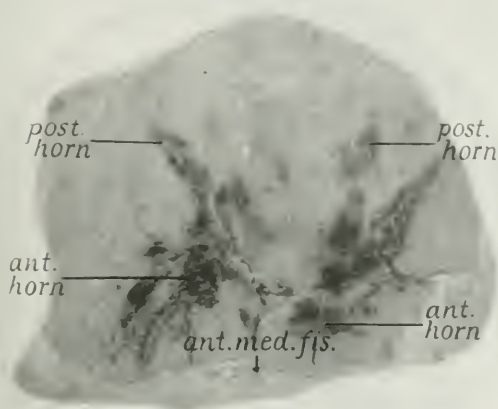


FIG. 5.—Case 3. Photomicrograph of lesion showing hemorrhage and slight fattening.

and extensors of the forearms. From this we thought the spinal lesion had not destroyed the 7th cervical segment completely. The superficial reflexes of the abdominal wall were also present. Spinal puncture showed uniformly bloody fluid.

The autopsy showed a fracture-dislocation between the 5th and 6th cervical vertebræ with slight displacement of the 5th on the 6th. Unfortunately the crushed segment of the cord was seriously damaged during its extraction, because as soon as the dura mater was opened the softened cord oozed out. A photograph of the gross specimen is shown in Fig. 6. The level of the lesion was crushed to a shapeless pulp permeated throughout with extravasated blood. No microscopic section was made here because it seemed to be completely disorganized. The gross appearances of the cord about 1 cm. above and below the lesion are shown in the picture. In that taken from above there is widespread extravasation of blood in the gray matter of both anterior cornua and in the deep part of the posterior columns abutting on the posterior commissure. In that taken from below, the cord is flattened obliquely and the extravasation is confined mainly to the centre of the section. From the upper end of this section, through

the part nearest the pulped area, the specimen shown in Fig. 7 was prepared. It shows such distortion of the cord that orientation was rather difficult. The anterior and posterior horns of one side and practically all the posterior columns of both sides are pulped. The crushed area is permeated with extravasated blood and completely shattered.

CASE V.—H. W. Sealy Hospital, Gen. No. 116594. Autopsy No. 1289. The patient was admitted to the Sealy Hospital on January 21, 1919, suffering from

symptoms of a complete transverse lesion of the spinal cord at the level of the 7th cervical segment of the cord, caused by a fall on the back of his head. When first admitted he could distinguish pin prick over several irregular areas in both legs. Later on there was complete flaccid paralysis with absent reflexes and complete anaesthesia to all types of stimuli below the lesion. He could move the arms and forearms sluggishly. He could flex the fingers of both hands slightly, but could not extend them. There was complete loss of control of bladder and rectum.

The X-ray showed that the body of the 6th cervical vertebra was broken and that it was separated slightly from both the 5th and 7th.

The patient failed rapidly. Breathing became labored, and before death Cheyne-Stokes' respiration set in. He died on January 27th, *i.e.*, 6 days after the accident.

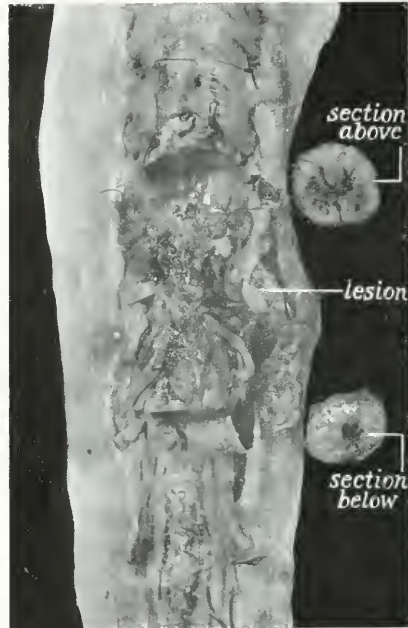


FIG. 6.—Case 4. Extensive destruction; with pulped cord flowing through tear in pia.

The autopsy showed softening and separation of the intervertebral discs between the 5th and 6th and between the 6th and 7th cervical vertebrae. The body of the 6th was fractured transversely (Fig. 8) and the right transverse process was broken off. There was a very small hemorrhage between the dura mater and bone at the level of the body of the 6th thoracic, but none inside the dura mater. The spinal cord at the same level was soft, flattened and dark colored from hemorrhagic extravasation in its substance. Unfortunately the whole cord was not preserved. Three blocks of the cord, taken respectively through the lesion, above it and below it were kept permanently. The appearance of these sections is shown somewhat diagrammatically in Fig. 8



FIG. 7.—Case 4. Photomicrograph of vertebral body fracture.



H.W. U of T Path Dept Autopsy No 1289 Fall on head or neck indirect violence
Fracture body & root of 6th CV Haematomyelia, died 6th day.
rupture of 5th & 6th discs Incomplete sensory loss in legs

FIG. 8.—Case 5. At the right are shown the hemorrhages above, through and below the lesion.

At the level of the lesion the cord was seriously crushed and there was considerable extravasation of blood throughout the gray matter. There were also two wedge-shaped symmetrical extravasations on either side of the anterior median fissure. The section taken 2 cm. below the lesion showed two small symmetrical extravasations in each anterior cornu. In the section taken about a vertebral segment above the lesion the hemorrhage was confined mainly to one anterior horn. The microscopic appearances are shown in Fig. 9. The areas of hemorrhage are shown at h. h. Vacuolation is present at the periphery, a. a. (Edema is present everywhere. It is especially intense in the neighborhood of the

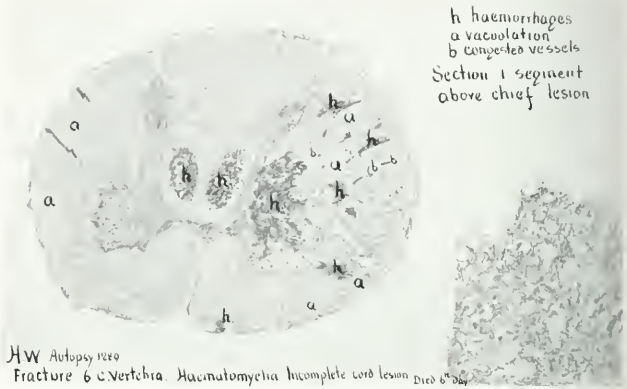


FIG. 9.—Case 5. Drawing of microscopic section above lesion.

hemorrhagic zones. The changes here seem to suggest that the open network appearance of the tissues surrounded by blood extravasation may represent the early stage of liquefaction of the disintegrated tissues which may finally terminate in the formation of vacuoles or actual cavities like those occurring in syringomyelia.

Remarks.—The three cases lived respectively 24 hours, 40 hours and 6 days. In all of them we found extravasation of blood scattered alike in gray and white matter. It was the outstanding feature. The degree of destruction at the level of the lesion varied greatly. In Case III the anterior part of the cord was compressed and distorted. In Case IV one-half the cord was pulped and destroyed. In Case V, the cord was crushed and flattened, but not completely destroyed. There was no oedema in either Case III or IV, but in Case V oedematous changes were seen in every section. In the cord above the lesion they were especially intense. It would appear from the absence of oedema in Cases III and IV, who survived, respectively, 24 and 40 hours, that it does not make its appearance so soon after the injury as some observers claim. There is no difficulty in recognizing it when present. The tissue assumes an open network appearance that is absolutely characteristic. It has

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appeared to us that some of the cedematous areas situated in the middle of dense extravasations of blood were in the early stages of liquefaction. In most of the sections we found oedema more marked at the periphery and especially in the lateral and posterior columns. In these situations it appears to represent the early stages of tract degeneration.

GROUP III. PATIENTS LIVING FROM TWO WEEKS TO A MONTH

CASE VI.—A. S. Hospital No. 103,459. Autopsy No. 915. Admitted to the John Sealy Hospital on September 24, 1915, suffering from complete paralysis

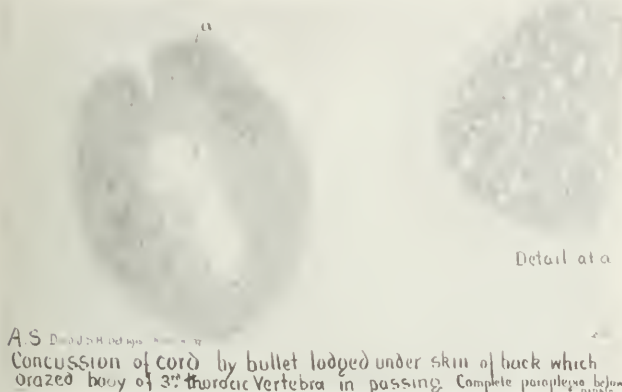


FIG. 1. Case 6. Dr. Joseph H. ...

and anaesthesia of the body below the level of the second thoracic segment caused by a bullet which had passed across the upper part of both left and right pleural cavities. The signs were those of a complete transverse lesion, *viz.*, absolute flaccid paralysis, total absence of every kind of sensation below the lesion and loss of control of bladder and rectum. Both deep and superficial reflexes were absent and never returned. The patient died on October 7th, *i. e.*, 13 days after the injury.

The autopsy showed a wound of the right lung, fracture of the 3rd left rib and a perforation of the body of the 3rd thoracic vertebra. In addition there was purulent cystitis and acute diffuse nephritis. The spinal cord was removed and the spinal canal carefully examined. There was no direct wound of the cord. The track of the bullet was shown by a slight elevation of the bony wall of the spinal canal in front. The dura mater was slightly torn. The cord and pia mater were untouched. There was a small extravasation of blood in the extradural space, but none in the subdural. The cord was slightly blood-stained and softened. It did not appear to be completely crushed.

A section of the cord through the lesion is shown in Fig. 10. The area of greatest destruction is in the gray matter and the posterior columns. Extensive cavitation is present in this area. Cedematous changes are present in every part of

the undestroyed cord. The detailed appearance of the oedema and vacuolation is shown in the insert at *a*. A section of the cord taken 2 cm. above the lesion (Fig. 11) shows two principal areas of destruction, one in the gray matter of one posterior horn and the other in the lateral column of the same side. The position of the posterior horn is occupied by a pyriform-shaped cavity. On the lateral wall of this cavity some of the nerve fibrils of the posterior horn can be seen. The cavity in the lateral column occupies the position of the spinothalamic tract. Its

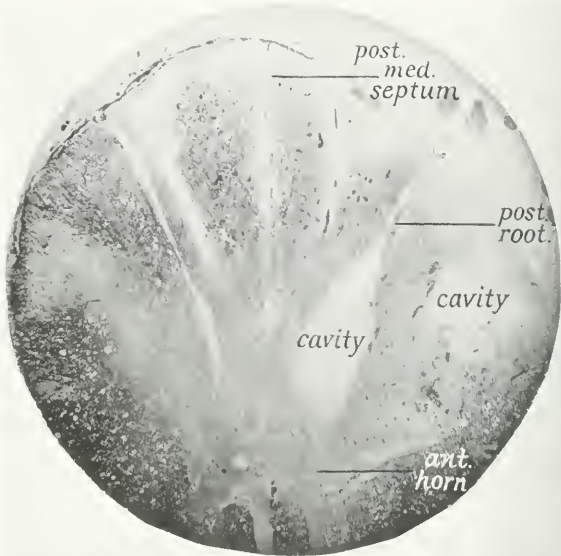


FIG. 11.—Case 6. Photomicrograph 2 cm. above the lesion showing oedema and cavitation.

walls are formed by disintegrated tissue and are poorly defined. In a similar position in the opposite lateral column there is an area of degeneration. Oedema is well marked throughout the section.

Remarks.—The area of destruction was much greater than we expected to find from the naked eye characters of the cord. Although the greater part of the lateral columns seem to have escaped disintegration, they are seriously shattered. The gray matter was completely destroyed for the distance of one spinal segment at the least. It is interesting to note that cavitation was also present in the section taken 2 cm. above the lesion. It is more than probable that the lesion was anatomically a complete transverse one. The case is particularly interesting because there was no direct wound or crush of the cord. The

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lesion was caused by vibratory impulses transmitted by the bullet during its passage through the body of the vertebra. Such cases are examples of pure concussion.

CASE VII.—W. L. U.S.P.H. No. 905. Autopsy No. 1415. Admitted into the John Sealy Hospital, September 9, 1920, suffering from complete paralysis and anæsthesia below the level of the 10th thoracic nerve, which had resulted from a fall of 30 feet into the hold of a ship. The back and legs were bruised. The symptoms were those of a complete transverse lesion, *viz.*, complete flaccid paralysis, complete anæsthesia to every form of stimulus, absence of complete



W. L. (U.S.H. 905)

Concussion of cord by fall. No fracture or dislocation 9th thoracic segment.

FIG. 12 A. (U.S.H. 905). Extensive pooling from concussion.

reflexes and complete loss of control of the bladder and rectum. The X-ray report pointed to a dislocation of the 10th thoracic vertebra. On September 11th (*i.e.*, two days after admission) laminectomy was performed by another surgeon. The laminae of the 10th, 11th and 12th thoracic vertebrae inclusive, were removed. Neither fracture nor dislocation was found. The fat and muscle over the vertebrae was infiltrated with blood. No blood was found in the spinal canal. No lesion of the cord was seen. The patient died on October 5th (*i.e.*, 26 days after injury), the cause of death being probably renal sepsis. During this period there was no amelioration of the symptoms. Reflexes never returned.

The autopsy was limited to an examination of the brain and spinal cord, which was done very carefully by Drs. W. Keiller and H. O. Knight. There was no evidence whatsoever of any fracture or dislocation of the vertebrae or any distortion of the spinal canal. The operation had failed to expose the site of the lesion of the cord which was at the level of the ninth thoracic segment. At this spot the cord was softened and diffuent. Above and below the lesion there were cavities filled with blood and disintegrated nervous matter. There was no hemorrhage either extra- or intradural. The microscopic appearance of

the injured segment is shown in Fig. 12, A and B. The normal tracts and areas are almost unrecognizable. Nothing except a nebulous mass of disintegrated tissue can be seen.

Remarks.—The case is a striking example of the effects of vibratory impulses on the cord. The absence of fracture or dislocation was proved beyond the shadow of a doubt by a painstaking examination conducted by two experts with the express purpose of finding out whether concussion was responsible for the symptoms or whether a fracture-dislocation had been overlooked at the operation. At the autopsy there was effusion of blood in the

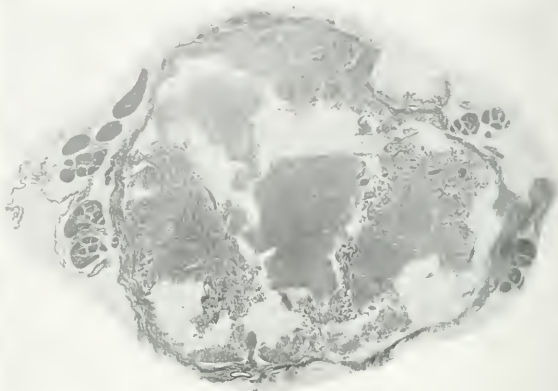


FIG. 12 B.—Case 7. Photomicrograph of Fig. 12 A.

spinal muscles over the greater part of the dorsal region. The mechanism of the fracture was probably a direct blow, probably horizontal in direction, caused by the impact of the back against the combing of the lower deck. Such complete destruction is unusual. The vibratory impulses must have been excessive and concentrated. No hope of recovery was possible because all conducting paths were destroyed totally.

CASE VIII.—F. L. Sealy Hospital, No. 120527. Surg. Path. No. 1365. The patient, a male, aged thirty-two, received a direct blow on the lower cervical spinous process from the handle of a hand car on July 7, 1920. The symptoms of a complete transverse lesion at the level of the 6th cervical segment were noticed at once. He was brought from Mexico to Galveston and arrived ten days after the injury. He was completely paralyzed and anæsthetic below the level of the 5th segment. All reflexes were absent. There were bed sores on the buttocks and heels. There was retention of urine and all the signs

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of septic cystitis. X-ray examination showed considerable forward displacement of the 6th cervical vertebra on the 7th.

He was very septic on admission, but later on the fever disappeared. Two days before his death respirations became very slow, from 6 to 8 per minute. He died of respiratory failure 20 days after the injury.

The autopsy was made after careful embalming. The 6th vertebra was found displaced forwards on the 7th so far that the spinal canal was occluded and the cord completely crushed, Fig. 13. The right upper articular process of the 7th vertebra was fractured. There was no meningeal hemorrhage. At the level of the lesion the cord was completely pulped and squeezed out of the sheath of a pia mater for at least 0.5 cm. The pulping of the cord extends upwards and downwards for at least a spinal segment in each direction, i.e., it includes the 5th and 7th spinal segments. On section of the cord above and below the lesion a central degeneration and hæmatomyelia extended upwards as far as the 4th segment, and downwards as far as the 1st thoracic segment. There was no adhesion of the dura mater and arachnoid to pia, and the subdural space above the lesion communicated freely with that below.

The appearance of the injured cord is shown in Figs. 13, 14, 15 and 16. At the site of the crush all trace of nervous tissue had been squeezed out of the pial sheath. A section at this level showed nothing but pia mater and nerve roots. A section taken 3 cm. above the crush (Fig. 14) showed a large cavity situated in the posterior column of white matter. It occupies the central part of the columns of Goll and Burdach on one side and abuts on the posterior cornu and the gray commissure. In the section taken 2 cm. below the lesion (Fig. 15) a smaller cavity was seen occupying approximately the same posture. Numerous small extravasations of blood are present in the gray matter and in the white matter of the lateral columns. At the periphery of the section, especially in the region of the lateral columns, there are marked evidences of edema. The section taken 2 cm. below the lesion shows similar changes. The cavity is much smaller and seems to be divided into two parts by a septum of disintegrated tissue. There is a localized edema at the periphery of the lateral columns. (See Case XII, Fig. 20.)

Remarks.—The great interest in this case lies in the cavitation of the interior of the cord. In discussing the mechanism of crushes of the cord mention was made of an area of disintegration which extends from the part crushed upwards and downwards. This is shaped like two truncated cones, the bases of which face one another at the site of the lesion, while the apices point upwards and downwards.

Soon after the injury the cone-shaped pulped area presents a characteristic appearance. It is traversed in every direction by fissures which split it up into irregular masses which separate it from the uninjured cord which surrounds it. Diffuse extravasation of blood is present in every part of the pulped area. Later on the whole area has a tendency to undergo liquefaction, which may be followed either by absorption resulting in spaces resembling those found in syringomyelia, or by the formation of cystic spaces containing a thin fatty fluid resembling pus in appearance.

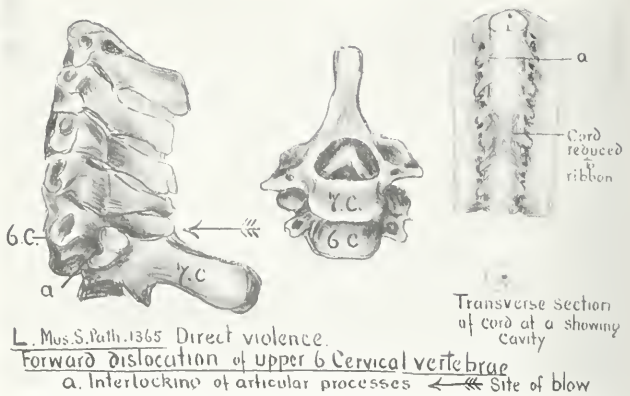


FIG. 13.—Case 8. Drawing showing deformity; narrowing of canal, and total crush of cord.

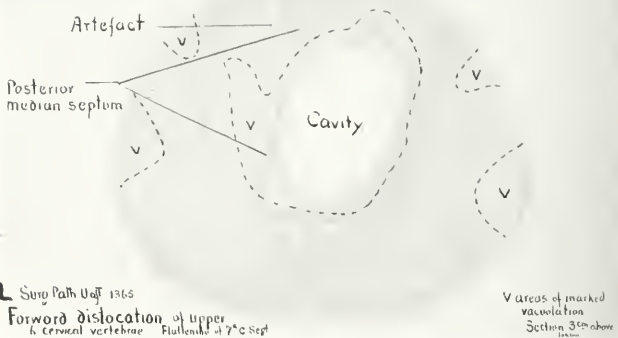


FIG. 14.—Case 8. Drawing of microscopic section 3 cm. above the lesion.

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FIG. 15.—Case 8. Drawing of microscopic section 2 cm. below the lesion.



FIG. 16.—Case 8. Photomicrograph 3 cm. above the lesion.

GROUP IV, CASES LIVING SIX WEEKS AND OVER

CASE IX.—Museum No. 22 J. A museum specimen with practically no history (Fig. 17, A and B). The appearance of the bone and soft parts leads us to believe that the patient must have lived a considerable time after the accident. There is no sign of extravasation of blood anywhere. The body of the 11th thoracic vertebra is fractured obliquely. From this, the line of separation passes backwards between the 10th and 11th vertebrae ripping up the intervertebral disc, and tearing through the interspinous ligament. The cord has been crushed very severely along the line of separation. It is represented by a cavity with walls of pulpy tissue. Above and below the crushed segment conical areas of disintegrated tissue are seen. They occupy the centre of the cord and are shown in the photograph by a dark stippling. Their bases abut on the injured segment and their apices extend upwards and downwards to the middle of the corresponding vertebra. Opposite the middle of the body of the 12th thoracic, the centre of the cord is occupied by a small cavity. A similar one, much smaller, is seen above opposite the upper part of the body of the 11th. No microscopic sections were made of this specimen because we were afraid that the method of preparation had changed its minute character. It was prepared by freezing and sawing the spine and cord sagittally.

CASE X.—Museum No. 191 I. A museum specimen with a somewhat scanty history attached. The patient was admitted to the Sealy Hospital with symptoms of a complete transverse lesion of the spinal cord at the level of the 3rd thoracic segment. There was complete flaccid paralysis with absence of all reflexes and total anaesthesia below the lesion. The patient lived for several months. Bed-sores developed and severe cystitis set in before death.

The specimen (Fig. 18) shows a transverse crush of the cord with permanent flattening for a considerable distance. The flattened portion, which is as long almost as a vertebral body, is tape-like and consists almost entirely of pia mater. A microscopic section at this level (Fig. 19) shows merely granular debris and a few nerve roots surrounded by a sheath of pia. Immediately above and below the constriction, the cord shows a bulbous enlargement.

Sections through these areas show serious destructive changes. The section above the lesion (Fig. 20) shows complete destruction of the anterior cornu and the anterolateral portion of one side of the cord and partial destruction of the anterior cornu of the other side. In the section below the lesion (Fig. 21) a similar but less extensive area is seen. Oedematous areas are distributed throughout both sections.

CASE XI.—O. G. Sealy Hospital, No. 39013. Autopsy No. 723. The patient fell into the hold of a ship and sustained a fracture-dislocation of the 7th thoracic vertebra, attended by symptoms of a total transverse lesion. He lived for 51 days, and eventually succumbed to sepsis of the kidneys and bladder. No operation was performed on the spine.

At the autopsy there was a marked kyphotic curve in the mid-dorsal region. A fracture was found situated in the body of the 7th thoracic vertebra. The spinal canal was considerably narrowed at this level. The appearance of the cord is shown in Fig. 22. The cord was severely crushed and flattened over an area almost equal to two vertebral segments. The dura and pia mater were so firmly adherent that they could not be dissected away from one another and from the cord without tearing. The cord was reduced to a narrow band of tissue of firm consistence contained in the tube of dura and pia. Several elongated narrow cavities which contained a grumous fluid are present in its substance. There were no signs of hemorrhage beyond a general dark staining of the crushed nervous tissue. The appearances are identical with those found at the time of operation, in Case XIII.

U of T. Path Museum 22 J.
Fracture of lower thoracic vertebra
no history

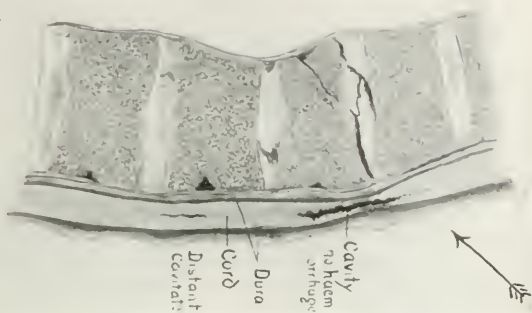




FIG. 19.—Case 10. Photomicrograph at site of lesion. No cord tissue present.

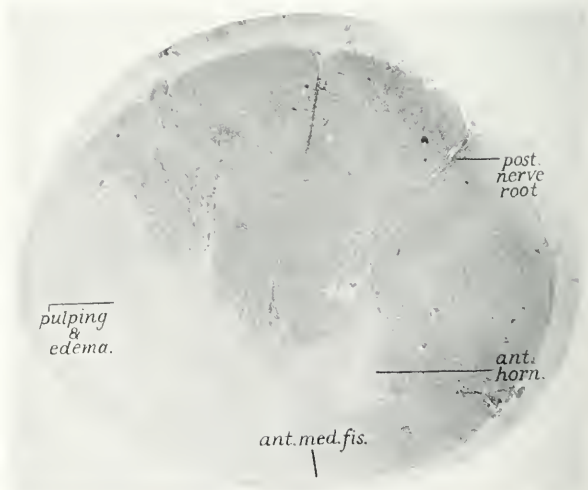


FIG. 20.—Case 10. Photomicrograph showing pulping and edema above the crush.

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CASE XII.—B. M. Sealy Hospital. History No. 956. Surg. Path. No. 1195. The patient was admitted to the Sealy Hospital on March 4, 1920, totally paralyzed and anæsthetic in his lower extremities the result of a fall from a height of 20 feet. The 11th and 12th thoracic spinous processes were very prominent. X-ray examination showed a fracture of the body of the 12th thoracic vertebra. Both legs were completely paralyzed and flaccid with complete absence of all reflexes.

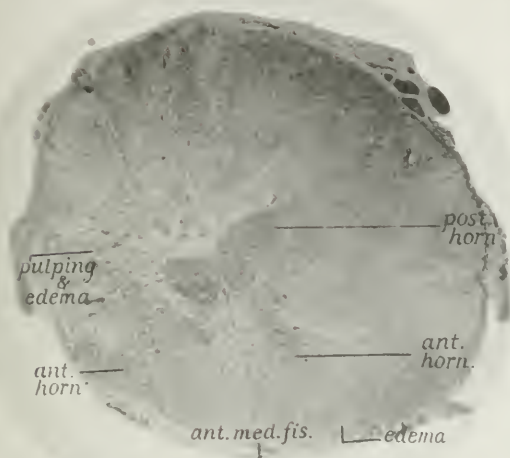


FIG. 21.—CASE 11. Photomicrograph showing pulp and edema within the crush.

Anæsthesia was complete to all forms of sensation up to a point on the front of the abdomen about 3 inches above pubic symphysis and laterally to the level of the iliac crests. There was no control of the bladder and rectum. In time bedsores developed on the buttocks, heels, toes and penis. There was no priapism. Death occurred 4½ weeks after the injury, from cystitis and renal sepsis. There was never any sign of return of the reflexes in the paralyzed limbs.

The autopsy showed forward displacement of the 11th thoracic vertebra associated with a fracture through the body of the 12th. The spinal canal was considerably narrowed. The spinal cord (Fig. 23) was completely crushed at this level, and the crushed cord is represented by a flat tape-like band of tissue lying in a sleeve of pia mater. The pia mater was not torn. The dura mater was intact and was not adherent to the pia. Sections of the cord above and below the lesion showed pulp and cavitation similar to that seen in Case VIII, but more extensive.

CASE XIII.—J. R. Sealy Hospital. No. 132672. On December 28, 1922, the patient was pinned underneath an overturned motor car. When extricated the lower

extremities were completely paralyzed and he had lost control of the bladder and rectum. He was admitted to the Sealy Hospital on March 13th. Examination showed that he was suffering from symptoms of a complete transverse lesion of the spinal cord below the level of the 12th thoracic segment. Sensation was present as low as the symphysis pubis in front, and laterally a slight distance over the iliac crest. All the reflexes below the abdominal were completely lost. Bedsores were present over the sacrum and heels. Urinary retention, which required catheterization at first, had now given way to dribbling. The bladder was not paralyzed, but overflowed. It did not contract in response to tickling of the inner side of the thighs. Paralysis and anaesthesia were complete in both legs. The muscles were flaccid and wasted. No reflexes of any kind were present. Anaesthesia was absolute to every variety of stimulus. The skin was dry and scaly.



FIG. 22.—Case 11. Dura, arachnoid and pia firmly adherent at the site of lesion; no cord tissue demonstrable here.

X-ray examination showed a dislocation forwards of the 12th thoracic vertebra on the 1st lumbar. The deformity was so excessive that the posterior edge of the body of the upper vertebra was in line with the anterior edge of the vertebra below. Under the skin of the back one could feel distinctly the upper articular process of the 1st lumbar.

The patient begged so earnestly for operation that I, against my better judgment, consented to perform a laminectomy. I removed the laminae and spinous processes of the 11th and 12th thoracic and the 1st lumbar vertebrae. The laminae and ligamentum subflavum of the 12th thoracic, and to a less extent, those of the 11th were firmly adherent to the dura

mater. At the lower border of the lamina of the 10th thoracic the dura looked fairly normal. Underneath the lamina of the first lumbar the dura was also normal. The dura mater was opened in the middle line from end to end. The normal subarachnoid space was opened above at the lower border of the lamina of the 10th thoracic. The dura was quite adherent to the pia opposite the body of the 11th and densely adherent opposite the body of the 12th. Opposite the first lumbar the subarachnoid space was not obliterated, but it contained very little fluid. While trying to separate the adhesions between the dura and pia opposite the body of the 12th thoracic a cystic cavity about half an inch long was opened from which flowed a turbid fatty looking fluid-like pus. The cystic cavity occupied the middle of the flattened band of tissue which represented the crushed cord. It was unrecognizable as nervous tissue. Over an extent of almost two spinal segments the cord had been destroyed. The lumbar enlargement was recognizable but somewhat smaller than normal.

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As far as could be ascertained by the naked eye the cord was completely destroyed opposite the body of the 12th thoracic vertebra. Nothing had been gained by the operation, as was surmised beforehand. Since the operation no change whatsoever has occurred, either in motion or sensation, or the return of reflexes.

Remarks.—All the cases in this group had lived a considerable time since the accident. We are uncertain about the exact time in Cases VIII and IX, but from the appearance of the soft tissues in Case VIII and from the autopsy notes in Case IX, several months must have passed between the history and death. Marked cavitation is seen in Case VIII, and the conical areas of disintegrated tissue show up clearly. Permanent narrowing of the canal had resulted, in Cases IX, X, XI and XII, from failure of the vertebræ to recoil. In each of these cases continuous pressure had moulded the crushed cord into a flattened tape-like mass or had forced it completely out of the sheath of pia mater. It seems probable that soft diffuent cord will flow backwards into the sheath of pia mater as soon as pressure is relieved by recoil of the bones, but that continuous pressure, such as exists where the deformity is permanent, will produce permanent flattening. In Case VI, diffuent cord had refilled the tube

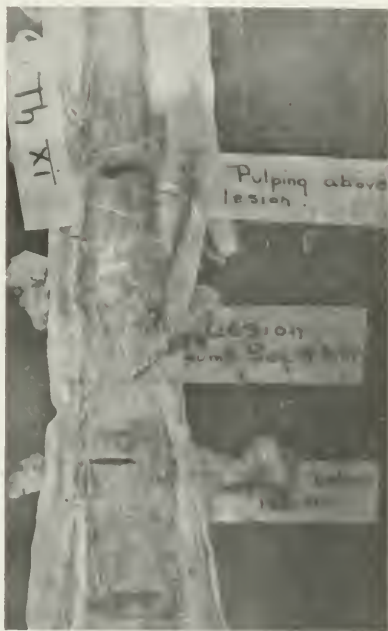


FIG. 23. —Case 12. Cord tissue squeezed up and down; empty tube of pia at site of lesion.

of pia from which it had been squeezed. Nevertheless it was disorganized completely, and for a considerable distance above and below the lesion cavities filled with blood and disintegrated nervous matter were found. If the sheath of pia mater is torn diffuent material will frequently flow out of the pial sheath into the subarachnoid space. In such cases, if the dura mater is opened at operation or at autopsy, the diffuent disintegrated cord tissue will ooze out of the opening. The microscopic appearance of sections taken through the crushed area shows fissures which traverse the cord substance in the direction of the exit of the pulped tissue through the torn pia mater. The arrangement

of the diffluent cord in parallel areas also suggests lines of flow or currents. Such appearances are shown in Figs. 7, 24 and 25.

In Case XII we had an opportunity of seeing at operation a crushed cord identical in most respects with those described in Cases IX, X and XI. A period of a little more than three months had passed since the injury and during this time the disintegrated nervous tissue had liquefied and lay in a cavity situated in the flattened band of tissue representing the crushed cord. It showed convincingly the futility of operative interference, because there was not a shadow of doubt that the destruction was absolute. The most hopeful and sanguine surgeon could hardly have persuaded himself that relief of pressure would produce a beneficial result.

By the courtesy of Adjunct Professor Joseph F. McVeigh of the Department of Anatomy, I have examined the spinal cords of several dogs which had been crushed experimentally with a view to causing a lesion as nearly as possible like that which would follow a fracture-dislocation. In each experiment the cord was exposed by nibbling away the spine and laminae of one or two thoracic vertebrae. Through the intact dura mater the cord was crushed either with the tip of a finger or the handle of a scalpel. In some of the experiments pressure was continued until the finger or handle of the scalpel was arrested by the vertebral bodies. In others less severe force was used. No attempt was made to measure the force employed, because the object of the study was merely to observe the changes that resulted in the traumatized zone and in the contiguous areas. We found in all cases that the changes were identical with those seen in human cords. The production of cone-shaped areas of destruction above and below the lesion when the crush was complete, the widespread hemorrhagic extravasation, the liquefaction of the disintegrated nervous tissue and the production of cavities were all observed. Moreover we were able to follow the separate steps of the degenerative changes because the regulation of the age of the morbid processes was completely under our control.

In Fig. 24 (dog 6) a curious distortion of the posterior half of the cord has occurred. The section was taken at the level of a crush in which only slight force had been employed. A slight opening had then been made in the dura mater through which clear cerebrospinal fluid flowed. The dog was killed 32 hours afterwards and up to the time of death the hind legs were completely paralyzed. The section shows that the posterior surface of the cord is drawn out somewhat like the stem end of a pear. The posterior columns and cornua are seriously broken up, and seem to be flowing backwards in lines resembling currents of lava. The appearances suggest strongly that the flow of disintegrated tissue is towards the hole in the dura mater which was made at the time of operation. The same appearances are shown in the human cord described in Case IV.

In Fig. 25 (dog 1) a considerable degree of force was used by the tip of the finger. The dog was killed at the end of 41 hours. The specimen taken through the lesion shows an excessive degree of pulping. It occupies all the posterior columns and the adjacent parts of the posterior horns and the gray commissure. Wide branching fissures extend in every direction between masses of disintegrated tissue. There is marked oedema in every other part of the section, particularly intense at the periphery of the lateral columns. The pulped area is permeated

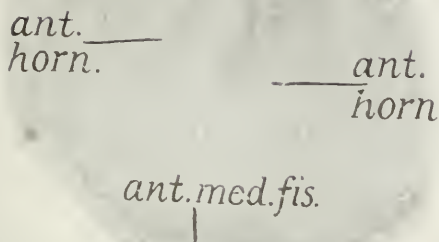


FIG. 24.—Dog, killed 32 hours after partial crush. Cord tissue flowing towards opening in dura.



FIG. 25.—Dog, killed 41 hours after the crush. Section above the lesion.

with extravasated blood and is a transverse section of the cone previously described. It is so completely cut off from the unshattered part of the cord which surrounds it, that liquefaction and cavitation would probably have resulted if the dog had lived long enough.

In Figs. 26 and 27 (dog 2) we are able to show the later changes. The dog was killed at the end of 2 weeks. The cone-like area of destruction has undergone liquefaction and absorption resulting in cavitation. The cavity is situated in the posterior cornua abutting on the gray commissure. The appearances are identical with those shown in the human cord in Case VIII.

In Fig. 28 (dog 5) a moderate degree of force was used with the handle of a scalpel. The dog was killed at the end of 20 hours. The distortion is great. Hemorrhage is present in both anterior cornua. The cord resembles closely the human cord in Case III.

In undertaking this study I was anxious to find out if the area of destruction of nervous tissue was absolute from the moment it occurred or whether it was progressive; in other words, whether morbid changes occurred in the neighborhood of the extravasations of blood which would ultimately lead to the death of nervous elements which were unhurt originally; and further, if such changes occurred whether it was possible to arrest them by operative procedures. It is unnecessary to discuss the question of regeneration of axis cylinders and the other intrinsic nervous elements of the cord, because no evidence has ever been advanced either from a pathological or clinical standpoint to support such a belief. We must accept finally the statement that regeneration never occurs.

Touching the question of progressive destruction, it is a very difficult matter to arrive at a sound conclusion, because the changes that occur are of an entirely different character to those met with after injuries of other structures of the body. The phenomena of active inflammation which always occur during the healing of gross tissues are never seen. There is nothing that resembles in the least degree the circulatory and cellular changes which are present in tissues undergoing repair. The processes, on the contrary, are of a passive nature, consisting of oedema followed by liquefaction and vacuolation. Oedema seems to occur inevitably, sooner or later, in or around the areas of extravasated blood. We found it present to a limited degree in one of the dogs at the end of 8 hours. It was always present in dogs who survived the crush for 24 hours. In our human cords, however, we found that it was absent in Case III, who lived 24 hours, and in Case IV, who lived about 40 hours. In all the cords of patients dying at a later date, oedema was seen in every part of the section, more intense in the areas of extravasation of blood; and, where life had been prolonged for several weeks, clearly demonstrable in the periphery of the cord. The significance of oedema is not clear. Some writers such as Frazier and Allen believe that it is the direct result of circulatory changes produced by ruptures of small arterioles, and that it is essentially progressive and destructive in its tendencies; in other words that nerve tracts that have escaped destruction by the primary injury may be destroyed later on by oedema.

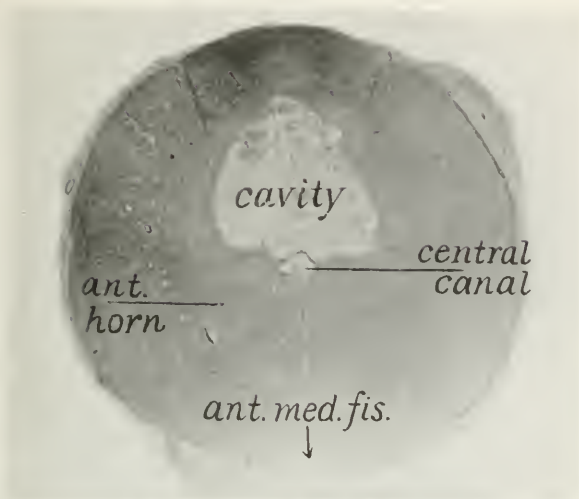


FIG. 26.—Dog, killed 2 weeks after the fracture. Cavity at site of the lesion.

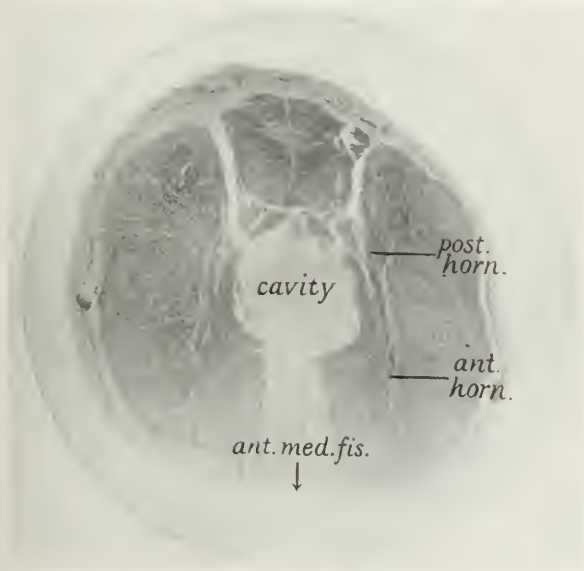


FIG. 27.—Same dog as Fig. 26. Section below the lesion. Cf. Fig. 16.

The experimental observations of Allen on the changes following contusion of the spinal cords of dogs led him to believe that the extravasations of blood occurring in the substance of the cord and under the pia mater were progressive to a certain point and that oedema made its appearance in the substance of the cord in fifteen minutes. An incredibly short time! He believed that



FIG. 28.--Dog killed 20 hours after partial crush. Deformity and hemorrhage at site of lesion. Cf. Fig. 5.

hour by hour disruption of the cord progresses, aided by hemorrhage and oedema, and that the condition of the injured segment is very much worse three or four hours after the accident than it is, say, at the end of the first hour. From these observations he concluded that, if the secondary changes in the cord, *viz.*, oedema and hemorrhage, could be prevented, many cases of total transverse lesion could be averted, and partial recovery of function secured. To this end he advised an incision of the cord through the contused level to drain away the effused blood and relieve the intramedullary pressure. The incision employed was carried longitudinally through the injured segment exactly in the middle line of the cord, separating it into two halves. He found

in cords subjected to this incision two hours after being crushed by a force which had been standardized so as to produce a complete transverse lesion, that he had been able to arrest the disintegration of tissue such as invariably occurs in non-operative cases. The experimental work on which these conclusions are based was carried out so accurately that the deductions are apparently logical and justified. It is difficult, however, to accept them unreservedly for two reasons; firstly, because paralysis and anæsthesia reach their maximum immediately after the injury, and are seldom of the progressive type; and secondly, because the changes seen in a crushed cord after incision are open to an entirely different interpretation.

The first objection is on clinical grounds. It is true that we occasionally see cases in which paralysis and anæsthesia are progressive, but they are the exception and not the rule. The following are examples. We have recently had under our care a patient whose motor paralysis pointed to a transverse lesion of the cord at the level of the seventh cervical segment. Sensation to pin prick was present in isolated areas distributed irregularly over the chest, abdomen and legs. The superficial abdominal reflexes were present but the cremasteric was absent. All the deep reflexes of leg were absent. There was no fracture of the spine and no deformity of the spinal column. The cord symptoms followed a severe contusion over the seventh cervical spine. A few days after admission the areas of sensation and the superficial reflexes disappeared and the upper limit of anæsthesia became definitely fixed. No change occurred afterwards up to the time of death. We have also histories of several cases of complete transverse lesions resulting from fracture-dislocation associated with deformity, in which the loss of motion was instantaneous, but sensation was not lost until later (Case V). Another patient, whose sixth cervical vertebra was dislocated forwards during a football game, asserted that he felt distinctly the pain caused by the forcible ripping of strips of adhesive plaster from his insteps when his shoes were removed.

Nevertheless, in complete transverse lesions paralysis and anæsthesia are usually definitely defined immediately after the crush. There may be some difficulty for a day or two in outlining accurately the upper limit of sensation by reason of the profound spinal shock or the fact that the lesion is not linear but diffused over several segments; but, when spinal shock disappears, the limits of paralysis and anæsthesia become definitely and permanently fixed. In partial lesions there is frequently a period during which spinal shock is so profound that the injured segment is unable to transmit any impulse through it. Such cases are often mistaken for examples of total transverse lesion until the return of function shows that some tracts have escaped destruction. Far from noticing signs of progressive destruction in such cases, recovery up to a certain point is smooth and uninterrupted.

The second ground of objection deals with the proper interpretation of the changes seen in a contused cord after a median incision. In his original article, Allen shows transverse sections of two injured cords. In one (Fig. 1,

Allen) no incision had been made and the cord was removed six hours after the injury. In the other (Fig. 2, Allen) a median longitudinal incision had been made two hours after the injury and the cord removed four hours afterwards. The first cord (not incised) shows extensive destruction of both the posterior cornua and both posterior white columns. The pia mater is intact and the general shape of the cross section is not much changed. The injured area for the most part is composed of disintegrated diffuent matter very loosely connected with firmer uninjured nervous tissues surrounding it. The second cord (incised) is considerably flattened laterally. Both posterior horns are missing and the space occupied originally by the posterior columns is almost obliterated by the collapse of the lateral columns towards the median line. A pyriform cavity apparently filled with blood occupies the unobliterated part of this space. The incision into the disintegrated area appears to have relieved pressure and to have allowed the diffuent material to escape. This has evidently been followed by collapse of the cord and approximation of the lateral columns, resulting in a decrease in the lateral diameter of the cord. There is no doubt that the substance of the cord is clearer and better preserved in the incised than in the non-incised specimen, but there is such a decrease in the transverse area of the cord that we cannot help feeling that the diffuent tissue which escaped from the incision carried with it a considerable amount of nervous tissue which was not seriously injured, and which might have been expected reasonably to have recovered if it had not been disturbed. We have previously pointed out both in human and dog's cords, that the area of disintegrated material is cone-shaped and that the apices of the cones are situated at a considerable distance above and below the level of the lesion. The cones consist of diffuent material, the quantity of which is quite considerable. It forms the thick creamy material which flows out of the pia mater when the cord is exposed. While it lies in the substance of the cord it acts as a support to the uninjured tissue surrounding it. Evacuation removes the support and the walls of the cavity cave in like the sides of a sand pit or the banks of a river when the waters recede. On these grounds we believe that evacuation is not without its drawbacks and dangers.

Even admitting that incision usually produces the beneficial results claimed for it *experimentally*, we must not forget that the method employed to crush the cord of a dog injures the posterior columns more frequently than any other part, and that they occupy the only really accessible part of the cord. On the other hand, it is impossible to drain the anterior and lateral regions of the cord through a median posterior cut; and we have found these areas not infrequently crushed in human cords. (See Cases III and IX.) Allen himself emphasized the fact that the progressive destructive changes reached their maximum in about four hours, and that after this time the picture did not change materially. Therefore it follows that the crushed cord must be incised immediately after the injury if we are to expect beneficial results. At the end of four hours the mischief would be complete and incision would then be futile.

One can imagine that a procedure hedged around with such restrictions must have a very limited field of usefulness.

At the present time there seems no probability of agreement as to whether operation is either advisable or justifiable. Some surgeons believe that operation should be performed in every case as soon as possible, in the hope of finding some conditions, such as hemorrhage or deformity, the removal of which will prove of benefit to the patient. Others never operate under any circumstances because they believe that it is useless to expect injured cord to recover. Extreme views are seldom wise. The middle course is always safest (*in medio tutissimus ibis*). I have personally for many years been strongly opposed to operation as a routine practice. It is often unsafe, rarely justifiable and usually futile. Except in the rare instances where median incision of the cord is the objective, mere exposure of the injured segment is all the surgeon can hope to accomplish, because deformity is seldom persistent and massive hemorrhages do not occur. I believe that the only positive indication for operation is the persistence of deformity of such a degree as to justify the assumption that the cord is subjected to pressure. Even with such strict limitations, incomplete lesions alone would be benefited. If it were possible to distinguish with certainty, complete from incomplete transverse lesions in the early period, the problem would be solved. At the present time we are unable to decide and consequently we must either wait days or weeks for unequivocal signs or operate early in the hope of affording relief. I firmly believe that waiting is the best and safest course.

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ACTINOMYCOSIS*

BY HERBERT A. BRUCE, F.R.C.S. (ENG.)

OF TORONTO, CANADA

PROFESSOR OF CLINICAL SURGERY, UNIVERSITY OF TORONTO

My attention has been directed to this subject by a recent case which, going on to a fatal ending, allowed of a post-mortem, which revealed the origin of the disease about the appendix. It is the latest of a series of four cases which I have had, and in reporting these I desire particularly to present this case of actinomycosis of the appendix.

The ray fungus which causes actinomycosis originates in the rust sometimes found on grain and grasses. It is common amongst cattle, producing

lump-jaw, and occasionally it is found in man, most frequently in the cervico-facial region, and less often in the region of the appendix. Rarely it is found in the lung or liver, and a few cases are on record where it attacked the central nervous system.

The conditions under which the ray fungus—the actinomyces bovis—attacks man are not quite clear, for a study of all recorded cases gives one the impression that while in America it occurs most frequently in those localities where the disease is most prevalent in cattle, in England it bears no such relation; and the

disease is by no means confined to millers and farmers, as the text-books would lead one to believe, but is seen amongst all classes. Men are affected much oftener than women, and the age incidence is between twenty-four and forty-five.

The routes of infection are from carious teeth or the throat to the cervico-facial region, as shown by the researches of Lord,¹ and from the lumen of the intestine in the abdominal variety, as pointed out by Wright.² Case I, here reported, which seems to show the appendiceal origin, tends to confirm the



FIG. 1.—Appendix and wall of abscess. 1. Wall of abscess. 2. Appendix communicating with abscess cavity. 3. Caecum. 4. Terminal portion of ileum.

* Read before the American Surgical Association, June 2, 1923.

early views of Ransom³ and later those of Battle and Corner⁴ and Cope.⁵ The spread of the disease occurs by continuity of tissue and never by the lymphatics. The abdominal variety frequently shows spread to the liver in the form of a portal pyæmia.

The disease is seldom recognized in the early stages, it being mistaken for one of the commoner diseases which it so closely resembles, until, in the majority of cases, it has a firm foothold in the tissues. The diagnosis is rendered difficult by the insidious onset and the essential chronicity of the lesions, but there are definite symptoms in each type of the disease which, when borne in mind, help toward avoiding the too common error of thinking

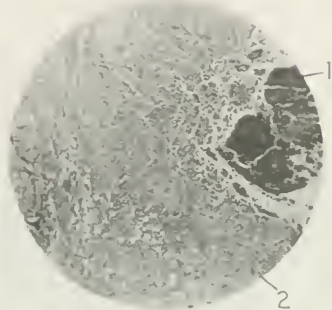


FIG. 2. (2) Lower view of wall of abscess cavity showing colonies of ray fungus. 1. Colonies of actinomyces. 2. Inflammatory reaction.

it a case of tubercular glands, Hodgkin's disease, sarcoma or appendicitis.

The cervico-facial type occurs in about eight out of ten cases, and while the swelling itself may not present any early distinctive features, the persistence of trismus independent of the size of the lump or any nerve involvement is pathognomonic. Later when the swelling, which is smooth, hard and painless, without any definite boundary, becomes hyperæmic, softens in places, breaks down discharging a little thick pus, heals and becomes puckered, and presents alongside the puckered areas new formed eminences going on to pus formation, the picture is unmistakable, and thorough and repeated search should be made by the surgeon or his assistant for the organism in the pus. A sinus may be found extending out from a neighboring carious tooth, as in Case II. The pus contains minute

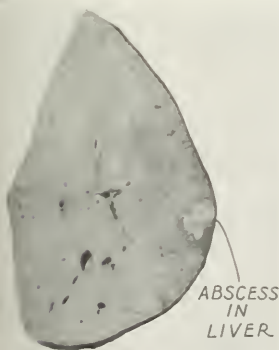


FIG. 1.—Liver showing actinomycotic abscess formation.

sulphur-like granules in which the ray fungus is seen when examined under the microscope. When these are found the diagnosis is no longer questionable, and active treatment is instituted.

In the abdominal type the diagnosis is not so easy, and one is very prone to mistake the condition for subacute or occasionally acute appendicitis. The mistake is not in considering the case one of appendicitis, for inflammation and actinomycotic involvement of the appendix is actually present, but in overlooking the nature of the infection which spreads to involve the retroperitoneal tissues, giving symptoms which identify the disease. The woody hardness of the tissues invaded by the *actinomyces bovis* accounts for one symptom which stands out as characteristic. It is the flexion of the right leg at the hip, due to involvement of the psoas muscle, and pain on attempting to extend the thigh.

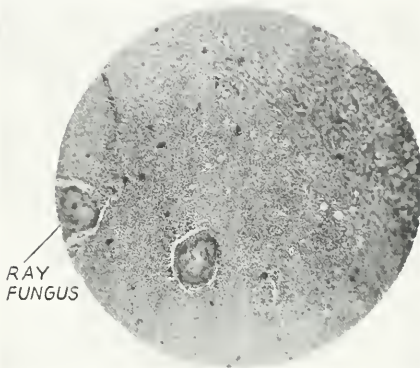


FIG. 4.—Section from liver showing ray fungus with abscess formation.

When this symptom is present and is accompanied by those which point to inflammation of the appendix or cæcum, and there are the physical findings of a painless hard tumor in the right iliac fossa, which has developed too rapidly to be a cancer and too slowly to be an appendiceal abscess, no involvement of the peritoneal cavity and only a moderate degree of constitutional symptoms, one should expect actinomycosis. The absence of

any lesion of the spine and fluctuation found in a psoas abscess rules out Pott's disease. Brockman⁶ groups the symptoms into four stages—(1) Varying abdominal symptoms mainly confined to the right iliac fossa, (2) The presence of a tumor in that location, (3) Sinus and fistula formation, and (4) Repair or dissolution. In the later stages of the abdominal types, when sinuses have formed, the diagnosis may be made by isolating the sulphur granules from the discharge.

Occasionally the disease may spread by continuity of tissue to involve the scrotum while remaining more or less hidden within the abdomen. Such cases are extremely misleading. Case I was of this type.

The prognosis depends upon the location and duration of the disease. In the cervico-facial lesion an early diagnosis gives good hope for a complete recovery, while in the abdominal type the mortality rate is 80 per cent.

Treatment resolves itself into local and general. The local treatment differs with the location of the disease. In the cervico-facial type total excision is desirable and usually possible. Along with excision, cauterization of the

tissue should be employed. The X-ray and radium have been used in the early stages of the cervico-facial type with varying success. In the abdominal type simple incision with drainage gives the best results. Curetting should not be undertaken.

Constitutionally the best success results from repeated large doses of potassium iodide. As much as 100 grs. three times daily may be given. Case II took 320 grs. daily for nearly a month. Along with this, autogenous vaccines of both the actinomyces and any accompanying infection, may be used. The vaccines have not proved of much value in the treatment. Bevan⁷ advocates the administration of copper sulphate $\frac{1}{4}$ to 1 gr. three times daily along with the potassium iodide, and local irrigation of sinuses with a copper sulphate solution 1 per cent. This treatment has also been used at the Mayo Clinic.⁸ Fresh air, sunshine and moderate exercise when possible are very important in the constitutional treatment.

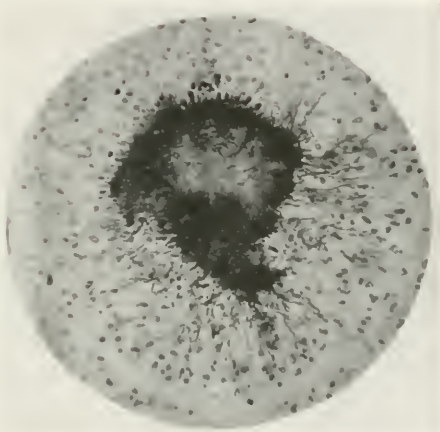


FIG. 1.—High-power view of the radiating actinomyces colony showing filaments and clubs.

CASE I.—Mr. P. L. Age fifty one. Had been in the railway service practically all his life. The present trouble began with acute abdominal cramps and diarrhoea. A few days later a swelling appeared in the right side of the scrotum, and a diagnosis of strangulated right inguinal hernia was made. The scrotum was opened by his local physician and a quantity of very foul smelling pus (with a fecal odor) was evacuated. In spite of this his temperature remained high and he became delirious.

When first seen by me on October 1, 1922, the right side of the scrotum was greatly swollen and the testicle had herniated through an opening in the skin. The opening was enlarged and the finger passed up to the external abdominal ring and freer drainage provided. On examining the abdomen there was no rigidity or tenderness in the right iliac fossa. There was considerable immediate improvement following freer drainage, but in a few weeks time he commenced to go downhill again, and on November 30, slight fullness having been noticed in the right iliac fossa, with flexion of the right thigh, Beck's paste was injected into the sinus and an X-ray made, which showed the sinus communicating with the iliac fossa.

I then opened extraperitoneally an abscess cavity lying on the ventor of the ilium, lined with granulation tissue, necrotic muscle and bone. It extended mesially to the transverse processes of the vertebrae and upwards along the psoas muscle. The situation, the destruction of the psoas muscle and ilium suggested tuberculosis rather than a lesion of appendiceal origin. However, the tissue removed showed actinomyces and filaments were also found in a Rosenow blood culture. Consequently potassium iodide was given orally and X-ray treatment commenced. In view of Osborne's findings, no iodide was given intravenously, as it was felt that a more constant concentration in the blood could be maintained by oral administration in divided doses.

The drainage persisted, being of a reddish-muddy type, about one to two drachms daily. The temperature ranged from 99 to 101. There was a constant leucocytosis (December 20th, 12,000; 78 per cent. polymorphonuclears. February 2nd, 22,660; 89 per cent. polymorphonuclears). During the last month he suffered greatly, and he became almost childish mentally, with progressive loss of strength and flesh, until he died on March 1st, after an illness of five months.

Post-mortem examination performed by Dr. G. W. Loughheed, disclosed the origin of the trouble about the appendix. In this region there was a large mass, with numerous adhesions. In the base of this mass was situated the appendix, which was attached to the muscles and the peritoneum of the crest of the ilium. Surrounding this was a collection of dark greenish pus. The external wound connected with this, so that there should have been good drainage.

The *liver* was very much enlarged, extending to the umbilicus. *Left pleural cavity* contained about 200 c.c. of dark greenish purulent material. *Right pleural cavity* showed some recent pleuritis. *Pericardial cavity* contained 20 c.c. of straw-colored fluid. *Left lung*; Near the anterior portion of the lower lobe of the lung is an abscess cavity which had perforated into the pleura. The lung on section showed areas of consolidation and small abscess formation scattered throughout the lower lobe. *Right lung*; Small abscesses the size of a pea are scattered irregularly throughout the whole of the lung tissue. *Liver*; markedly increased in size, weight about 2800 grams, surface smooth, has a dull gray appearance and cuts with resistance; leaves grease on the knife. Scattered throughout the liver are numerous small nodular masses which are beginning abscess formations. The central veins are slightly congested. *Left kidney* larger than normal; capsule strips readily; cortex rolls out; has a grayish appearance; the pyramids are slightly congested; pelvis contains a slight increase in peripelvic fat. Scattered throughout the kidney substance are small abscesses the size of a pin's head. *Right kidney* similar to left. *Pancreas* apparently normal. *Suprarenals* show slight congestion. *Appendix* is about 3 inches in length; lower end thickened and is attached to brim of pelvis and situated in pocket of pus. The peritoneum around this area shows small yellowish areas of pus, probably spreading from the tip of the appendix. *Spleen* is increased in size. On section its surface has a dull red appearance. Some pulp on scraping; tuberculae are not prominent. There is some evidence of perisplenitis present.

Microscopic Examination.—Section from the abscess cavity around the tip of the appendix shows tissue infiltrated with polymorphonuclears, lymphocytes, plasma cells and gathered together in granulomatous areas, in the centre of which are situated ray fungi. This fungus shows distinct rays with some clubs present. *Liver* shows irregular infiltration with these granulomatous areas, and numerous ray fungi present. *Spleen* shows infiltration of polymorphonuclear leucocytes and deep congestion. *Kidneys* show occasional colony of actinomyces, similar to liver. *Pancreas* is apparently normal. *Suprarenals* apparently normal. *Bowel* shows slight congestion. *Heart muscle* shows congestion, slight inflammatory infiltration

ACTINOMYCOSIS

around the blood-vessels. No colonies found. Ray fungus scattered throughout the *Lungs*, rather irregular small abscesses, the centres of which show ray fungus. *Left lung* near the anterior free margin shows a perforation into the left pleural cavity, with necrosis of the lung tissue. *Left testicle* apparently normal, shows slight congestion.

CASE II.—Cervical. L. B. Age thirty-nine. He had a swelling in the right submaxillary region, associated with a tender lower first molar tooth, from which pus was discharging through a sinus into the mouth. On extraction of the tooth examination of the pus revealed the ray fungus. Under large doses of potassium iodide the swelling in his neck diminished slightly, but a hard mass remained and was removed by operation.

Section of this showed the typical appearance of actinomycosis. He continued on treatment with iodide of potassium for a period of six months, at one time taking 320 grs. a day for about three weeks. At the end of six months he was apparently entirely free of the disease and treatment was discontinued. Five years have now elapsed without further manifestation of the disease, he is in splendid health, and I think we may consider that a cure has been effected.

CASE III.—A male, aged forty; a town-dweller, sent into my service with a mass in the right iliac region, which developed slowly, and had an indurated, solid feeling to it, very closely simulating carcinoma of the cæcum. On making an incision some pus was evacuated, and drainage instituted; the pus showing the actinomyces fungus. He was some months in the hospital under iodide treatment, and left slightly improved. I am not able, however, to give the ultimate result.

CASE IV.—Male, forty-five years of age, with actinomycosis of the left lung. Drainage instituted.

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HERNIA THROUGH THE CONJOINED TENDON*

OR

HERNIA OF THE LINEA SEMILUNARIS

BY FRANK S. MATHEWS, M.D.

OF NEW YORK, N. Y.

THIS paper deals with a type of hernia which in its anatomy, significance to the individual, its prognosis and treatment, differs as much from the ordinary direct hernia as the latter does from indirect hernia. If any hernia lying to the inner side of the epigastric artery is considered a direct hernia, then this type of hernia is also direct, but if included among the direct hernias it would be necessary to divide the latter into two distinct sub-classes. To call them hernias of the linea semilunaris leads to some confusion, because they are located only at one point of the linea semilunaris. Apparently the most accurate designation would be "hernia through the conjoined tendon" using old terminology, or "the falx inguinalis" using the new. This calls attention to its location, and to the fact that the hernia perforates this portion of the abdominal wall and is not a diffuse yielding of it, as is the case with the typical direct hernia.

A brief reference to anatomy may not be out of place. When one opens the inguinal canal of a very muscular subject and removes the cremaster muscle, Hesselbach's triangle is exposed to view. Above, the lowermost fibres of the internal oblique have a thick abrupt margin; the lowermost fibres seem to me to extend inward and but slightly downward to end in the linea semilunaris, and have little connection with the conjoined tendon. The transversalis muscle emerges below the lower border of the internal oblique, and either quite covers or almost covers the space down to the inguinal ligament. These fibres arch downward and inward, and at their termination inward, there is an area at the inner side of the triangle of firm consistency which is called the conjoined tendon, or falx inguinalis. The weakest portion of this posterior wall, according to the anatomists consulted and clinical experience, is just mesial to the deep epigastric artery, and close to the inguinal ligament. Here, even in muscular subjects, muscle fibres may be deficient. When this is the case, the posterior wall is said to be made up of a fascia transversalis. In subjects of weak musculature, the lower portion of the transversalis is poorly developed, and its giving way marks the starting point of a direct hernia. As the hernia enlarges it spreads across the triangle to the edge of the rectus, and in such cases a conjoined tendon is a scarcely demonstrable structure. In subjects, however, with a strong musculature, one at times encounters an opening, usually circular in outline, in a well developed conjoined tendon, lying close to

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HERNIA THROUGH THE CONJOINED TENDON

the rectus border, with Poupart's ligament below and to its outer side having a fairly firm fibrous margin made of conjoined tendon fibres.

This type of hernia is no doubt much less frequent in its occurrence than the ordinary direct variety, but is not by any means a surgical curiosity; all surgeons of experience with hernias must have encountered it a number of

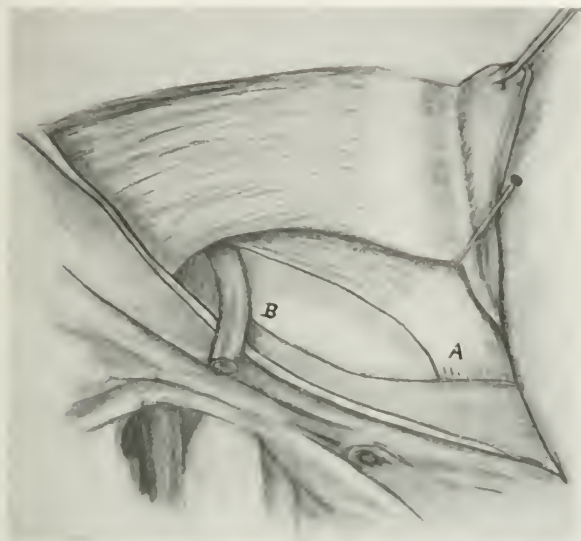


FIG. 1.—Semi-diagrammatic dissection of right inguinal region. A, Location of point of emergence of semilunar line hernia. B, Location of point of emergence of direct inguinal hernia.

times. In the preparation of this paper the writer has reviewed the records of eleven cases seen within the last three years at St. Luke's Hospital.

It is rather surprising that one sees so little reference to it in the literature. The older editions of Gray's Anatomy clearly contrast the two varieties, and suggest a different relation in the two cases to the obliterated hypogastric artery. Erdmann in a sentence says "direct hernia often emerges through a definite split in the fascia"; Downes clearly distinguishes the two types of hernia, calling the one direct and the other hernia of the linea semilunaris. He brings out both in the text and drawings the different locations and anatomical peculiarities of the two hernias. Most descriptions of direct hernia fail to mention this variety, hence are inaccurate when hernias of the conjoined tendon are included in the direct variety. The clinical side may be best presented by showing the points of similarity and contrast to direct hernia.

1. Neither direct nor conjoined tendon hernia is seen in children. Direct

hernia is practically confined to adult males. Conjoined tendon hernia is seen, but less frequently, in females.

2. Direct hernia has a wide and lax neck often difficult to define accurately. Conjoined tendon hernia has a small tight neck formed by the fibres of the tendon.

3. Conjoined tendon hernia is unilateral; direct hernia is usually bilateral, and is the result of muscular weakness.

4. Direct hernia may be associated on the same or opposite side with indirect hernia; the same has been observed in conjoined tendon hernias. I have even seen a conjoined tendon hernia associated with a fairly definite direct weakness.

5. One of the most important contrasts concerns the liability to strangulation, the small conjoined tendon hernia strangulating with the same ease as does the femoral hernia, while the direct hernia has little tendency to incarceration.

6. They vary also as regards the content of the hernia. The direct hernia may be said to always have a sac; conjoined tendon hernia may consist and frequently does consist only of a mass of prolapsing fat. The bladder is frequently present either with or without a true peritoneal sac.

7. In operating on direct hernia one often sees the obliterated hypogastric artery lying to the inner side of the sac, or arching over its inner portion. In conjoined tendon hernias the hypogastric cord, if seen, has usually been found on the outer side of the neck of the sac. In other cases with a true peritoneal sac present, the hypogastric cord has not been in evidence, but I have been able to satisfy myself that it must lie to the inner side of the hernia. The attempt to draw a distinction between the two types of hernia according to their relation to the hypogastric cord, has seemed to fail as an exact criterion, though it is probably true that the hypogastric nearly always lies to the inner side of a direct hernia, and frequently, at least, to the outer side of the conjoined tendon hernia.

8. The prognosis of conjoined tendon hernia is better and the treatment simpler than that of direct hernia.

9. This hernia presents an oval inguinal swelling quite similar to that of direct hernia, and lies beneath the external oblique aponeurosis, with the conspicuous difference that the swelling is unilateral and usually noted in muscular subjects.

10. As regards diagnosis it may be said that prior to operation, we have several times suspected the conjoined tendon variety and found it, but in a much larger number of cases have suspected this variety and found the diagnosis incorrect, operation revealing a direct hernia, or an ordinary inguinal bubonocele.

Of the eleven recent cases forming the basis of this report, the ages varied from 33 to 62 at the time of operation, the average being 43 plus years. The

bladder was present in the herniation a number of times, and was accidentally injured once.

The size of the hernia has varied, a number being quite small, the largest not larger than a hen's egg; four have been incarcerated or strangulated; two strangulated while in the hospital awaiting operation, and were operated upon in the course of a few hours; each contained a knuckle of small intestine. One patient, a woman aged forty, complained of a hernia in the left groin, which whenever it protruded, became very hard and painful, compelling her to lie down and maintain pressure until the swelling disappeared. Other conditions made an abdominal section necessary, at which a calcified tumor in the left ovary was discovered as large as a walnut. This could be readily pressed up into the hernial sac, which had a tight neck just admitting two fingers, and which lay to the inner side of the obliterated hypogastric.

One hernia of this group recurred promptly after operation. The patient was a man aged fifty, who had worn a truss for some years; for three days he had had a tender mass at the external ring, and there had been vomiting and general abdominal pain. Operation revealed a strangulated herniated mass protruding through an opening in the tendon three-fourths of an inch in diameter. The mass appeared to be inflamed fat; on investigating this mass in the search for a hernial sac, a cavity was found containing considerable turbid fibrinous fluid. A finger inserted into this cavity entered the abdomen; further investigation, however, showed that the finger had not entered the peritoneal cavity. A sound in the bladder demonstrated that that organ was not in the hernia, and that it had not been injured. The hernia then consisted of a mass of fat from the prevesical space which had become strangulated, with considerable fluid exudation both within the abdomen and outside the constricting ring. Three stitches closed the opening and a Bassini operation was added. A drain was left in the lower angle of the wound. The hernia has recurred and is partially controlled by a truss. The patient's lower abdomen is very fat and prominent.

This is the only recurrence in the group of eleven cases, but I recall another hernia of this type in a woman operated on more than ten years ago which required a subsequent operation, and so far as I know has since remained cured.

The treatment of this type of hernia is comparatively simple. One should be careful not to let a conjoined tendon hernia escape observation when operating for an indirect inguinal hernia. This might very well occur when the hernia is small in size, and would give one the impression later that the original hernia had recurred. When the opening is small, it is readily closed by one or more mattress sutures. At times the upper margin may be brought down to Poupart's ligament. One of the ordinary operations for strengthening the posterior wall of the canal may be added. The question comes as to what should be done with the hernias of larger opening, or recurrent hernias like the one mentioned above. In addition to closing the opening in the fascia, one might consider the lateral displacement of the rectus margin, suturing it

to Poupart's ligament, thus attempting to bring this muscle behind the opening in the conjoined tendon. Another possibility would be to fortify the opening by a reflected portion of the anterior rectus sheath. It would add additional security to this region if the cord were brought out superficial to the external oblique, with closure of the external abdominal ring.

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END RESULTS OF ARTERIAL TRANSPLANTS

BY OSKAR KLOTZ, M.D.

OF SAO PAULO

HOWARD H. PERMAR, M.D., and C. C. GUTHRIE, M.D.

OF PITTSBURGH, PA.

FROM THE DEPARTMENT OF PHYSIOLOGY, UNIVERSITY OF PITTSBURGH

IN recent years much interest has been taken in the surgery of blood-vessels, and since the revival of the work by Carrel and Guthrie¹ in 1905, many new fields for the application of the procedure have been suggested. In the early endeavors, the repair of wounds of arteries, such as might be received in battle or accidents, appeared to be the extent to which the limited technic would permit interference with the arterial walls. Carrel and Guthrie were, however, able to perfect a technic which permitted the more extensive invasion of the field of surgery of the arteries, and which to-day opens up possibilities which would previously not have been attempted. Subsequently they applied their technic, demonstrating the variety of ways in which arterial and venous circulation could be reestablished, and the ability of the various types of vascular tissue, even under extremely unnatural conditions, to serve adequately for the permanent restitution of arteries and veins. Naturally, this work was all performed on animals before any attempt was made to apply it to man. Their results demonstrated, and they have been abundantly confirmed by others, that repair is a practical undertaking, either by means of a simple suture of the injured walls or by the employment of patches or segments of vascular or other tissue. For example, a vessel from which a portion of the wall has been removed can be repaired by a tissue such as peritoneum, or a segment of a vessel can be removed and the vascular channel restored permanently by introducing a segment of artery or vein either from the same or a different species of animal, in either the fresh (or surviving) or dead condition. Examples of the latter are segments of formaldehyde preserved tissue or tissues preserved by refrigeration.

In repairing an injured or diseased artery by implanting a segment of another vessel, we are confronted by a problem of three aspects. Firstly, a technic which will permit handling the vessel wall without developing secondary results as hemorrhage or thrombosis; secondly, reestablishment of an adequate circulation through the segment interposed between the cut ends of the artery; thirdly, the implanted segment must continue to carry

on the circulatory function of the original segment regardless of the changes which may affect its tissues. It is in connection with the last part of the problem that our present interest mainly lies. The technic of the operation on experimental animals is well established, and when properly mastered does not often fail to give satisfactory results. Occluding thrombosis is infrequent. Naturally the results obtained in experimental animals yield a greater percentage of successful results than can be hoped for from similar operations carried out upon diseased vascular tissues in man.

Respecting the second point, we have come to learn that a great variety of tubular structures can serve as a conduit for short distances, and that although the inserted conduit does not possess the elasticity nor the factors for the regulation of the blood flow, this becomes a minor point when the major problem, the restitution of the circulation, is taken into account. Thus, to permit an adequate amount of blood to reach a given organ, like the kidney, it is necessary to insert a tube of sufficient calibre between the separated ends of the renal artery. A glass tube, or a silver or gold tube can be made to serve quite adequately to restore the circulation. But with tubes of this kind the permanency of the operation will remain in doubt, inasmuch as such hard inorganic tubes can never become welded with the living tissues, and although an inflammatory tissue will surround these tubes and hold them in position, there is always danger that the adaptation of the tube to the tissue will become loosened and secondary hemorrhage result. Moreover, metal tubes tend, sooner or later, to encourage thrombosis, even though their surfaces have received special treatment before insertion.

The operative features of the excision of a segment of artery and its substitution by another tubular structure of some kind having been demonstrated as feasible, the important issue in the problem was the determination of the best structure which could not only serve as a temporary conduit, but which would also give a permanency to the undertaking. For this purpose living segments of arteries from the same animal or from other animals of the same species were used; later it was found that segments of living veins could be employed in restoring the circulatory continuity of a divided artery or vein. Finally, however, it was shown that in such implantation of living hetero-vascular segments, few if any cells of the implanted portion survived, yet good functional results were obtained.² It was then found that satisfactory results could be obtained by inserting a devitalized segment of an artery or a vein.³ Such tubes could be prepared at leisure, preserved in a formaldehyde solution, and, when required, the appropriate length could be cut from the preserved tissue and after removal of the formaldehyde and impregnation with oil or vaseline, could be interposed between the ends of the cut artery.

The question, however, arises as to the final outcome of these introduced tubes; how long can they serve as vascular conduits; and are there any secondary conditions arising in the inserted segment which may eventually destroy their function?

The reports by various authors upon the value of vascular transplantation in surgery have usually been made upon experimental investigations, in which

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the experimental animal was kept under observation for a period of a few weeks or a few months. Carrel reports observations upon one dog in which



FIG. 1.—Auto-transplantation. Dog. Common carotid artery on common carotid artery. Twenty-eight days.



FIG. 2.—Auto-transplantation. Dog. External jugular vein on common carotid artery. Twenty-eight days.

the interposed segment functionated for four years.⁴ Watts⁵ carried out his observations after twenty-six days, Fischer and Schmieden⁶ after 86 days and Levin and Larkin⁷ 11 days after the operation. In general the

results of the various authors agree that it is not very important which kind of vessel is used to reestablish continuity of a divided vessel, granted that the calibre is adequate for the circulation.

AUTO-TRANSPLANTATION

A. *Artery on Artery* (Fig. 1).—If a segment of an artery be removed and promptly replaced by suturing so as to reestablish the continuity of the vessel, the results are excellent, not only from the functional, but from both the morphological and histological standpoints. After a few weeks, morphologically the implanted segment can scarcely be identified, and histologically the structure is essentially the same as the unengrafted parts of the vessel.⁸

B. *Vein on Artery* (Fig. 2).—A segment of vein similarly engrafted on an artery shows a moderated enlargement, with thickening of the wall through fibrosis, and disappearance of muscular tissue. Apparently the fibrous thickening of the wall proceeds to a point where the tendency of the segment to dilate is overcome, and the two processes become stabilized. Good permanent functional results are obtained.⁹

An analysis of the end results in two cases of transplantation of vascular segments is here given. They illustrate the similarity of the functional results regardless whether living heterologous tissue is used in transplantation or whether devitalized vascular segments are used.

HETERO-TRANSPLANTATION

Rabbit aorta on carotid artery of dog.—(Fig. 3).—In 1907, one of us (Guthrie)¹⁰ carried out a successful experiment in which a segment of rabbit's aorta was interposed between the ends of a divided carotid artery of a dog. This experiment was performed on May 15, 1907, a young dog with a fairly marked goitre being used. A short segment 0.5 cm. long was excised from the left common carotid and a segment of the abdominal aorta of a rabbit was implanted. At the time of the operation it was noted that the rabbit aorta was considerably smaller both as to the size of the lumen, the total diameter and the thickness of the walls than the dog's carotid. The rabbit aorta was obtained from an animal which had just been killed. On the completion of the operation the circulation was quickly restored. One month later (June 15, 1907) the site of operation was again reopened and the implanted segment was found to have dilated so that it was now of equal size to the common carotid to which it was joined. The segment also appeared longer than when transplanted. The circulation through it was good. On December 15, 1907, the segment and the neighboring portions of the carotid artery were removed. At the time of this operation, the circulation through the implanted segment was good. It was found, however, that the segment was still larger than when previously examined. It had dilated so that the interposed rabbit aorta was of greater diameter than the carotid of the dog. Furthermore, the segment was longer and while lying *in situ* was more rigid than the arterial tissues to which it was attached. The lumen was patent and there was no thrombosis. After the segment was removed, the following observations were made.

Macroscopic.—The specimen consisted of a segment of artery measuring 3.75 cm. in length. The artery showed a lumen without any evidence of thrombosis. The specimen showed the ends of the carotid artery attached to a dilated

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segment possessing smooth glistening inner walls. The carotid artery at either extremity was of normal size, being about 0.25 cm. These portions of the carotid artery were soft and pliable with a normal character to the inner lining and with no evident change in the wall.

The interposed segment which measured about 2.8 cm. was very different from the tissues of the dog's carotid. In the first place, the lumen was wider than either the proximal or distal ends of the carotid; secondly, the walls of this inserted segment (rabbit aorta) were abnormally hard, irregular in thickness and in a number of places showed a calcareous deposit. The points of junction between the segment and the carotid formed an annular slightly thickened border which projected to a slight degree into the lumen. On holding the opened specimen to the light, it could be seen that the wall was of irregular thickness, and that, opposite the thinner portions, slight secondary sacculations had developed in the tissues of the interposed and dilated segment. The walls of the segment were dense with fibrous tissue and were thicker than the dog's carotid. Broadly speaking the interposed segment formed a fusiform dilatation in which no part of the living carotid to which it was attached was involved. By naked eye it could be seen that the interposed heterologous segment had been clothed both on its inner and outer surface by a living tissue derived from the neighborhood.

Microscopical.—Sections were made through the segment of the implanted artery. These sections showed an inner layer lined by endothelium, underneath which a laminated fibrous tissue structure lay between the implanted segment and the lumen. This layer of fibrous tissue was a living tissue showing no structure as is usually seen in the intima of arteries, but was of uniform laminated character from the endothelial surface down to its contact with the remains of the implanted segment. This fibrous tissue layer showed well developed collagen fibres and many fibrous tissue cells lying in small spaces between the fibres. No muscle elements were present.

The mid-portion of the wall was occupied by what remained of the implanted segment. In appearance, the structure was more compact and hyaline than a normal artery. The elastic elements could no longer be recognized with their specific characters. The general direction of the specific fibres could be observed but they were closely compacted and seemingly fused into a homogeneous mass. Scattered through it were a number of connective tissue cells which lay in little lacunae between lamellae. On the inner side of the old segment the homogeneous and collagen-like material seemed to coalesce, at least in part, with the collagen fibres of the new inner coat. No inflammatory cells were recognized in or about the old segment and no true granulation tissue was present. The inner border of the old segment was of irregular outline appearing as if absorption of it was in places progressing more rapidly than in others. It is readily evident that the amount of tissue of the original segment had been greatly reduced both through the compacting of its fibres as well as through absorption of its inert matrix at the borders. In the middle of the old segment was a layer of calcareous deposit, which was laid down in collagen fibres in fairly dense arrangement. Nevertheless many small lacunae were present in this calcareous mass within which cells with round- or spindle-shaped nuclei were found. In



FIG. 10.—Hetero-transplantation. Rabbit aorta. Fig. 11.—Common carotid artery. As a type of transplantation.

one place a true osteoid tissue was developing in the midst of the calcareous deposit; osteoblasts were present and in the centre of the deposit was a space like a narrow cavity lined by an endosteum and containing groups of irregular cells.

It was very evident that the old segment had become invaded by fibrous tissue cells arising from the host and that a calcareous degeneration and pro-

gressive absorption of the original tissue was taking place. It was interesting to observe that the collagen fibres of the inner coat were merging with the matrix of the original segment, as if in the reabsorption of the inert collagen material of the implanted segment these materials were being utilized in the development of the collagen arising in the fibrous tissue of the host.

To the outer side of the segment was another laminated layer of connective tissue resembling that beneath the endothelium. Collagen fibres were regularly disposed and contained normal-looking fibrous connective tissue cells. Blood-vessels were found penetrating this coat as far as the old segment; a few lymphocytes were seen about the blood-vessels. This layer was not uniformly attached to the old segment but in places there was a narrow space as if union had never occurred. This layer was quite compact and dense and to the outer side of it was found the loose supporting tissue like an adventitia.

It is clearly evident that the host had supplied the new tissue which clothed the artery on the inner side of the implanted segment as well as the compact structure which bounded the segment on its outer side. There was no longer evidence of an inflammatory response and the tissues had arrived at a passive state when the enclosed segment alone was undergoing change by calcareous degeneration and slow absorption. It is interesting that the segment itself received some of the new

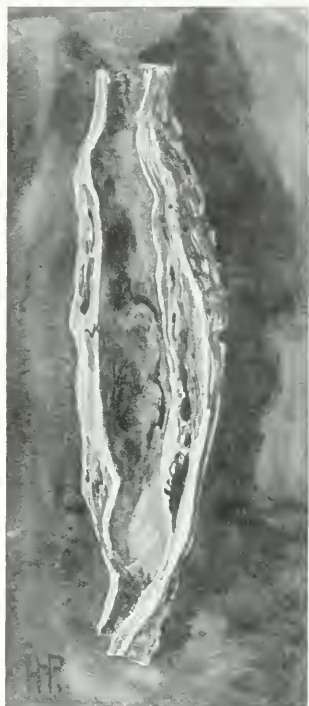


FIG. 3b.—Hetero-transplantation. Rabbit aorta on dog common carotid artery. Seven months later.

connective tissue cells which not only surrounded it but became scattered through its interstices, while some of them in contact with the calcareous deposit took on by metaplasia the property of bone cells with the development of an osteoid tissue.

RESTITUTION OF ARTERIAL CONTINUITY BY MEANS OF DEVITALIZED TISSUE (VEIN) (FIG. 4)

January 22, 1908, dog No. 3.—Medium sized young bitch in good condition. Doctor Guthrie divided the right common carotid artery and interposed and sutured a segment of formaldehyde-fixed vena cava of a dog between the ends

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of the artery, thus restoring arterial circulation. The immediate mechanical result was good.²¹ The wound was closed and the dog made a rapid and uneventful recovery.

The implanted venous segment had been preserved for sixty days in a 2.5 per cent. solution of formalin. The day prior to the operation the vein was removed from the formaldehyde, washed in dilute ammonia, dehydrated with

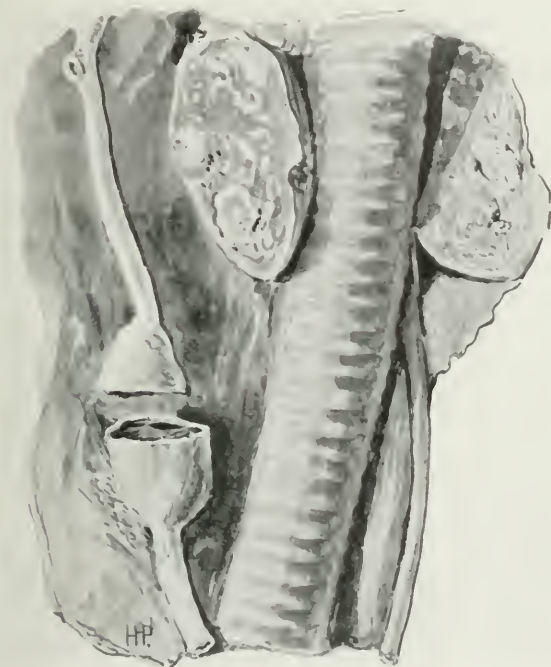


FIG. 4.—Transplantation of devitalized (formaldehyde-fixed) segment of dog vena cava on dog common carotid artery. Eleven years.

absolute alcohol and impregnated with paraffin oil. It measured 0.75 cm. in length and 0.5 in diameter. On establishing circulation, it exhibited a diameter greater than that of the artery.

February 12, 1908. By palpation the pulse in the two common carotid arteries appeared the same. The animal was again anesthetized and the artery and segment exposed. The circulation through the segment was active. In size the segment showed marked expansion. After temporary occlusion of the artery by pressure on either side of the segment to prove the patency of its lumen and the continuity of the arterial lumen on either side, the wound was closed and again the animal made a rapid and uneventful recovery.

February 20, 1908. Pulsation equal in both common carotid arteries as determined by palpation. The animal was demonstrated on this date before the St. Louis, Mo., Medical Society. The animal remained in good condition and gained much in size. Pulse remained good in both common carotid arteries.

October, 1909. Animal shipped to Pittsburgh where it remained in the Medical School kennels until March 20, 1919, the date of its death which resulted from disease not associated with the experimental operation.

Clinical examination, from time to time, demonstrated equal pulsations in the two common carotid arteries. On the right side, at the site of operation, a dense nodular structure could be felt in the course of the artery. The animal raised pups in 1909-1910, and whelped several times in immediately succeeding years, but failed to raise litters. She remained in excellent condition except after occasional fights with other dogs, until age led to a general physical decline. For about six months prior to death, the decline grew increasingly more marked, and for several weeks preceding death she showed great physical weakness, with loss of appetite; emaciation became correspondingly evident. Two days before death she was barely able to rise to her feet, and was unable to stand for more than a minute. An examination revealed the pulse in both common carotid arteries to be the same by palpation. The animal died suddenly.

An examination shortly after death revealed the two scars of the previous operations, the first, for the operation proper, January 22, 1908, and the second, for exposing the structures for direct examination, February 12, 1908.

A complete autopsy was performed and it was found that the dog had died of a sarcoma of the sternum which had produced metastases in the ribs, heart, liver, spleen, and lymph-nodes. Here we will record only the findings in the cardio-vascular system.

Macroscopic, Heart and Blood-vessels.—The heart, aorta and vessels of the neck were removed in one piece. The heart was enlarged. The left ventricle was well contracted and its walls were hypertrophied. The right ventricle was much dilated; its walls were thin and quite pale. The musculature of right ventricle was quite soft and scattered through it were a number of small yellow areas of tumor formation varying in size from a small wheat grain to a large flat mass which almost completely occupied the right auricular appendix. No tumor masses were observed in the tissues of the left heart. The right ventricle was much dilated and contained dark post-mortem clot. The pericardial sac was clear and glistening. The aorta and its branches at the neck appeared normal.

The right common carotid was patent and could be readily examined up to the point where it entered a fusiform aneurismal sacculation which was 3.5 cm. in length and 2 cm. in width. This mass, which lay along the direction of the common carotid, was shaped somewhat like a large almond and felt quite firm. Along its upper inner border the patent common carotid artery continued. The patency of the vessel was demonstrated up to and beyond its bifurcation. The external carotid shortly after its origin showed the presence of a recent adherent clot and was still pervious. The dilated segment was pervious and communicated with both portions of the common carotid which entered it. This was demonstrated by gently compressing it when it was found that the fluid contents were driven in opposite directions. The mass had an outer sheath of greyish connective tissue which passed in a longitudinal direction while an inner pigmented structure could be recognized through this outer layer. The superior thyroid artery was patent. Careful examination of the surrounding vessels—external jugular and internal jugular—demonstrated them to be patent and normal. The vessels on the left side of the neck were normal.

Implanted Segment of Vein.—A section was made through the middle of the implanted segment which was found to be in a state of dilatation resembling

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a fusiform aneurism. When the vessel was cut across a large part of the dilated lumen was occupied by a recent dark red clot, leaving a channel along one edge about the size of a straw. The size of this channel was about the same as that of the carotid artery. The tissues were prepared and sectioned in paraffin. It was found that a process of calcification occupied about one-half of the circumference of the implanted segment and it was necessary to decalcify the tissue before cutting it.

Microscopical.—The sections of the tissue showed a rather peculiar structure. A narrow rim of the original implanted segment of vessel could be followed in almost the entire circumference. This rim of tissue had a hyaline appearance and with Van Gieson's gave a reaction resembling connective tissue. There were no muscle elements to be found. A few granular dots were demonstrated in what was originally the media of the implanted segment; they represented the remnants of the elastic fibres arranged in a circular fashion. Elastic bands no longer existed but only small chains of granules which apparently were undergoing further destruction and removal. On both sides of this tissue, which could be recognized as the remnants of the media of the implanted segment, there was found a connective tissue growth which towards the lumen formed nodular masses arranged in laminae and bounded on the inner border by an endothelium. This latter coating however was absent in a large portion of the circumference where the blood clot was attached to the vessel wall. The nodular thickening of the inner coat varied much but appeared to be made up entirely of a type of connective tissue. Arising from this inner structure there projected into the lumen a band of tissue which was a part of a fold like a diaphragm which was disposed in a longitudinal direction of the lumen of the vessel. This fold did not completely cross the vessel lumen. It was made up of connective tissue and blood clot was attached to it. On its free surface a reaction resembling a granulation tissue was found and at one point there was a group of cells similar to the tumor cells which were found at the sternum. To the outer side of the media was a tissue mainly of the nature of connective tissue which was quite vascular and to which the artery was attached. This appeared to be the tissue of the surrounding parts for it had various elements such as nerves and large blood-vessels arranged in its structure. The character of the tissues suggested the remains of an old reaction in which granulation tissue had given rise to a fairly large quantity of connective tissue stroma.

Thus the vessel wall as it now exists is seen to be composed of an outer vascularized connective tissue coat of some thickness, which is adherent to a structure of dead connective tissue and partially destroyed elastic fibres (remnant of implanted vessel). Some of the connective tissue from the outside was found to have projected along with blood-vessels into the implanted structure. On the inner side of this old vessel wall is a new connective tissue structure varying in thickness like a nodular endarteritis and from which a band-like fold projects into the lumen.

Products of degeneration were found to occupy the wall of the old implanted vessel. A portion of it showed calcification. In the regions where granulation tissue led to the removal of some of the original transplant, blood pigment was found in fair quantities phagocyted within endothelial cells. Occasional areas of calcification were also found to occupy the thickened masses forming the new intima.

The thrombus within the lumen consisted of a recent blood clot along with cellular structures containing elements like the cells of the tumor of the sternum. It would appear that the tumor mass had localized within the vessel and after growing for some time suffered secondary necrosis, which was readily recognized both in the gross and microscopical sections.

Even with the presence of blood and tumor thrombus a lumen sufficient to preserve the circulation of the carotid remained perfectly patent. Even at this time, the cross-sectional area of the lumen through the segment was greater than the cross-sectional area of the lumen of the artery on either side of the segment.

Carotid Artery.—Sections of the carotid artery taken on the proximal side of the segment showed a healthy unaltered arterial structure.

In this case we have an experiment upon a dog in which a venous segment (devitalized) had served to preserve the circulation of the common carotid artery for a period of eleven years or until the time of her death which resulted from a tumor of bone. The implanted segment which at the time of the original experiment had been devitalized by preservation in formalin persisted in parts of its structure, there still being remnants of collagen and elastic fibres of the original implant. There was a considerable development of connective tissue around the segment which sustained its walls and sufficiently invaded the dead tissues of the segment to firmly hold it in place. This growth of fibrous tissue was the outcome of the development of a granulation tissue. It is interesting that the original dead elements of the segment were not entirely removed. A process of calcification occupied lateral portions of the segment where contact with the granulation tissue was obtained. The inner surface of the segment was clothed by a layer of connective tissue of varying thickness with an endothelial covering. This new inner coat did not appear to have its origin from the periphery, and it is assumed that it has arisen by a process of extension from the inner coat of the carotids to which the segment was united. In some places the new inner coat formed projecting strands not unlike heavy leaflets whose mode of origin was not clear. It is possible that their beginning was associated with small localized thrombi.

The introduced segment and its secondary walls were uniformly dilated to give rise to a fusiform dilatation. The segment was also lengthened. The incomplete thrombus which was found at autopsy was a late process and in part resulted from the localization of metastatic tumor growth, though it is probable that the mechanical conditions prevailing in the lumen, and the slowing of the circulation during the latter days of the animal's life were important contributory factors in the production of thrombosis.

These two cases illustrate very well the late events taking place in implanted vascular segments. The second case which we report is interesting in indicating that an implanted segment can continue to serve adequately as a conduit for the blood for a period of at least eleven years.

It has been shown that in hetero-transplants very probably and in devitalized transplants certainly the permanent effectiveness of the operation is due entirely to proliferative activity on the part of the living tissues of the host, both the vascular endothelium and the connective tissues taking part in the process of vitalizing the engrafted segment. The active proliferation of the living tissues may be augmented by certain mechanical factors associated with the flow of blood through the transplant, under which are to be considered: (1) The distention and movement of the segment due to blood

pressure. (2) The mechanical infiltration of the segment by blood plasma before it becomes lined by endothelium. There are also certain factors associated with the processes of reaction and repair following the introduction of the graft; (1) the resurfacing of the lumen by endothelium, with the subsequent development of a layer of subendothelial connective tissue, and (2) the deposition of fibrin about the graft as well as the simple presence of the graft itself as a foreign body in the tissues, both of which stimulate connective tissue growth.

The latter factor readily lends itself to investigation and an experiment to determine its importance was performed on a young dog, in which the object was to bring a vascular segment into close proximity to a large vessel without forming any connection whatever with the circulation. Segments of formaldehyde-fixed dog's veins were prepared from the material employed in earlier experiments with fixed transplants. The segments were treated in the same way as for artery grafting. A dog was subjected, under ether anaesthesia, to the usual operative procedure necessary to expose the right common carotid artery. Three prepared segments were anchored at equal distances along the course of that vessel, and secured by a loose loop of fine silk thread around the artery, after which the wound was closed. Healing occurred promptly without evidence of infection. The dog was kept under observation for eight months (June 22, 1920, to February 15, 1921), and at the expiration of that time the animal was employed in a class demonstration. The implanted segments were recovered at autopsy. In the gross, the implants were identified as three small indurated nodules along the course of the right common carotid artery; they were about the size of a split pea, irregular in shape, and in color varying from a yellowish-white to a brownish-grey. They showed no definite increase in size, nor was there any gross evidence of active tissue proliferation about them. They were preserved for microscopic study.

After fixation, the tissues were cut in paraffin and duplicate sets of sections from each nodule were stained by hæmatoxylin and eosin, Mallory's anilin blue stain, Van Gieson's stain, phosphotungstic acid hæmatoxylin, and by Weigert's and Verhoeff's elastic tissue stains. Control sections were also made from the same fixed dog's veins that had supplied material for the implants.

The microscopic findings may be summarized without going into the details of each implanted segment, since the three were practically identical. The control segments (from the vena cava of a dog) showed the typical histologic structure of a large vein, in which the two striking things are the very narrow medial coat and the wide fibrous adventitia; in the latter, great quantities of collagen and many short wavy elastic tissue fibres are present. These were, of course, cut transversely to the long axis of the vessel, an advantage not possible in the study of the implanted segments of vein, as much distortion had occurred during the eight months following the operation. One of the three segments appeared in the section properly cut in the transverse diameter. The others were cut obliquely. In general, the implants were found to have preserved enough of their structure to enable one to identify them and even to distinguish the media and the adventitia. Nuclear staining, however, was lacking and the muscle tissue of the media showed no differential staining when special methods were used. The entire implanted segment took a diffuse stain such as occurs in degenerated tissue. The elastic fibres were an exception. They were recognizable by their pale buff stain and refractile quality with phosphotungstic acid hæmatoxylin and by their black or blue-black stain with the special elastic tissue methods. Thus it is seen that there was every evidence of degenerative change in the elements of the

transplanted segments with only the elastic fibres retaining any degree of their specific staining quality. The cells and collagen fibres were also swollen somewhat and the structure of the vein wall was loosened, especially at the periphery. This was largely the result of a slight connective tissue proliferation, which had occurred in the immediate vicinity of the implanted tissue following a very mild inflammatory reaction due, no doubt, to its presence. No evidence of inflammatory cell exudate was present and there was no indication that granulation tissue had formed in the reaction. Adipose tissue had filled interstices about the borders of the implanted vascular segment and appeared in small areas in the periphery of the degenerating adventitia.

In the histologic elements of segments of a devitalized vein implanted in the tissues alongside the intact common carotid artery there developed, after eight months, such extensive disintegrative changes that only a certain number of the elastic fibres retained differential staining quality adequate for identification. The original question of the ability of such tissue implants to induce extensive encapsulating fibrosis by their mere presence must be answered in the negative, since it was shown by this experiment that the response of the living tissues is of the slightest degree, consisting of nothing more than the slow development of a few connective tissue cells, which grew for a short distance into the implant and which, together with adipose tissue, simply tended to obliterate any sharp line of demarcation between living and dead tissue.

The perivascular implantation of devitalized vascular segments indicates that the mere presence in the tissues of implants of this type, with the associated fibrinous exudate incident to the operative procedure, is capable of stimulating only a slight proliferation of connective tissues. It would therefore seem probable that the mechanical factors mentioned, either directly or by leading to a greater infiltration of blood plasma into the engrafted tissues, or possibly its escape into the surrounding tissues, account for the differences in the tissues implanted by the two methods.

The final result of the implantation of vascular segments from the functional standpoint is very similar, whether the segments are living or dead, whether they are homologous or heterologous. This has also been the experience of others. Furthermore it is found that hetero- or devitalized implanted segments always suffer more or less aneurismal dilatation, wherein there is some danger of the development of secondary thrombosis. These dilatations are usually fusiform, increasing the size of the lumen beyond the original diameter.

Surviving heterologous or devitalized vascular segments undergo extensive disintegrative and absorptive processes. It is therefore evident that in inserting such a vascular segment between the divided ends of an artery or vein, we are only attaching a temporary organic frame-work which is capable of serving as a tube to carry blood, and which is later more or less replaced by a permanent living structure, by the tissues of the host. The cellular portions of these transplants are lost and undergo autolysis, but the interstitial substance, particularly the elastic fibres and the collagen fibres of the

connective tissue, resist the process of dissolution for considerable periods of time. The tissue substances become more resistant when treated with formaldehyde solution. The colloidal state of the fibres is altered. Thus a formaldehyde-fixed segment will retain its shape and structure longer than will the untreated segment. This insolubility of the tissue has an advantage in that one can feel secure that the segment will not give way under the blood-pressure during the reestablishment of the new vessel. However, it also has the disadvantage that it does not adapt itself to the growing tissue.

Nageotte¹² and others believe that they have been able to demonstrate a repopulation by cells, of the inert interstitial structures of fixed connective tissue, when these were implanted in vascular areas. The collagen fibres of implanted segments lend their substance to reconstruct new fibres, and it is even stated that the old inert fibres become welded to the new ones, so that no division between old and new can be recognized. That such welding or amalgamation does occur between the inert substance of old and new fibres, we have been able to observe in a number of instances, but we are not convinced that this is a permanent fusion. It appeared to us that fusion of fibres was a physical fusion of two colloidal substances, whose properties were not necessarily identical, as is evidenced in the greater attraction of calcium salts by the altered fibres of the implanted segment. Even after such fusion of fibres, those of the implanted segment continue to undergo change, being slowly absorbed and replaced by new substance. Only when the fibre has been encrusted with calcium salts does the process of absorption and replacement come to an end.

It is probable, as Villard, Travernier and Perrin¹³ state, that blood-vessels preserved in the refrigerator before implantation are not living structures as was claimed by Carrel and are destroyed and absorbed like other killed segments. They only represent an elastic skeleton of the artery, susceptible always of being invaded by the cellular elements of the host which furnish a vitality sufficient to assure continuity of the vessel on which it is implanted.¹⁴ Thus the strength of the segment is at first dependent upon the compact inert elements of its wall, but later these give way to the increasing responsibility assumed by living tissue growing into the segment from the tissues of the host. Analysis of Carrel's reported observations bears out this view.¹⁵ For the instances in which he claims to have observed muscle tissue, months after the operation, in segments of dog's arteries kept in an ice box for weeks before engrafting between the ends of divided arteries of dogs, merely agree with the well-known fact that time is required for the complete disintegration and absorption of engrafted devitalized tissue.

His reported findings further confirm the fact, well known to surgeons, that absorbable tissue (catgut) is rendered more resistant to absorption by impregnation with vaseline.¹⁶ For he states that tissues kept in vaseline before use gave better results than tissues kept in salt solutions or blood. In the three successful operations reported with the use of vaseline-treated

arterial segments, examinations after three, five, and six months respectively showed that disappearance of muscular tissue was proportional to the time between operation and examination. Also, the results tend to show that the magnitude of change varies directly within limits with the time the tissue was kept in cold storage, *i.e.*, when transplanted after only twenty-four hours in cold storage, three months later good preservation of structure was observed, while segments transplanted fourteen to twenty-three days after being placed in cold storage showed much more extensive alteration when examined five and six months later.

In the first of these experiments in which the segment had only been excised for twenty-four hours, the tissues may have retained a certain degree of vitality, for, as is well known, blood-vessels or even the heart may be caused to show contractile response some days after their removal.¹⁷ Mac-William and Mackie¹⁸ observed contraction in arteries from amputated limbs in response to mechanical stimulation after twenty-four to forty-eight hours, but there was slight effect from chemical stimulation after the third day.

Carrel's results are of particular interest in showing that, in comparison to venous segments employed for arterial restitution, arterial segments may show but little dilatation enlargement over periods up to six months. This difference in the behavior of arterial and venous segments is accounted for by the differences in the thickness and structure of the walls, the arterial not only being much the thicker, but especially by the relatively more abundant elastic tissue fibres with their relatively great resistance to disintegrative and absorptive processes. Notwithstanding these qualities, arterial segments are reinforced by encapsulating connective-tissue proliferation as are venous segments. This is well illustrated by one of Carrel's figures in which this fibrous reinforcement of the segment is included in the drawing.¹⁹

The vitalization of such tubes takes place from two sides. Firstly, the lumen of the tube is rapidly clothed by a layer of endothelial cells, growing from the ends of the intima of the cut vessel, and secondly, the outer surface of the segment becomes surrounded by a granulation tissue of only moderate intensity. It is this external granulation tissue which actively reconstructs the tube, and which utilizes the framework of the inserted segment to permit new living cells to populate the foreign structure. The granulation tissue brings no muscle fibres with it to replace this type of tissue of the media. Connective-tissue cells are the only new cells which assist in reconstruction. These same cells may, under conditions of metaplasia, give rise to bone and cartilage.

The speed with which endothelial cells can clothe a denuded surface is always striking. An artery which has had the endothelial cells removed from its intimal surface will show complete regeneration in forty-eight hours. A quiescent thrombus will become covered by an endothelial layer in an equally short time. It is probable, although we have no studies upon this point, that an endothelial tube is reconstructed within an implanted segment within a

very short time. These endothelial cells develop by continuous multiplication, forming plaques which although usually only one layer deep often show areas which are three, four or five cells deep. No subendothelial fibroblasts develop at this time. The endothelial cells gain their nourishment from the circulating blood within the tube, and proliferate independently of the other tissues.

The disintegrative processes which are always found in devitalized or non-surviving implanted segments occur in the implanted portion itself. These degenerations are most commonly of a calcareous nature and will be observed after a period of four or five weeks. The calcareous process continues to increase for many months until the entire structure appears converted into a more or less brittle tube. As, however, portions of the implanted segment are absorbed, and as the rate of absorption varies with the different kinds of segments, the actual amount and distribution of calcification in any particular specimen varies greatly. In relation to these deposits of lime salts it is not uncommon to find small islands of osteoid tissue lying between the calcareous mass and the granulation tissue which surrounds it.

Thus, however, with all the changes which take place within the implanted segment, and around it, we find that such a segment can serve the purpose for which it is adapted. It serves as a conduit for the circulating blood, and as a framework upon which is built a new tube by the tissues of the host.

In all instances in which a dead segment serves its purpose for more than a month or six weeks, we find that an aneurismal dilatation occupies its length. This fusiform sacculatation persists not only during the existence of the segment, but permanently with the reestablishment of the new tube. The presence of such a fusiform dilatation may predispose to the development of a thrombus at a time long after the effects of the operative interference have disappeared as is the case with true aneurisms. Usually the extent of the sacculatation is limited, but it may attain considerable proportions in relation to the vessel to which the segment has been attached. In one of our cases the aneurismal pouch became the site for the localization of a metastatic tumor growth, around which a thrombus subsequently formed. The development of saccular dilatation in these living heterologous or dead segments further substantiates the evidence that the most important lesion which leads to dilatation is a loss of the strength of the media. It is the structure of the media in the implanted segments which is never accurately reproduced. As we have said, the reconstruction of the segments fails to replace the lost musculature as well as a great portion of the elastic fibres. In the absence of these tissues, the strength and elasticity of the restored artery is reduced regardless of how well the injury may be repaired by connective tissue. Dilatation is the natural consequence, and it will continue until the resistance of the new tissues in the adventitia can withstand the blood-pressure within the artery. In the second experiment here recorded, this dilatation persisted for a period of eleven years without interfering with the circulation.

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RELATION OF SURGERY TO THE VASCULAR SYMPATHETIC SYSTEM*

By WALTER A. SHERWOOD, M.D.

OF BROOKLYN, N. Y.

FROM THE DEPARTMENT OF SURGERY, BROOKLYN HOSPITAL, SERVICE "B."

THE following anatomic and physiologic facts have been well established and are generally understood and accepted. The walls of the arteries are supplied with both medullated and non-medullated nerve fibres. The former are a part of the central nervous system, while the non-medullated fibres are axones of the sympathetic system and form a part of what Langley terms the autonomic system. Although related to the brain and spinal cord by means of so-called pre-ganglionic fibres, they all reach their final distribution in the periphery by way of the sympathetic ganglia and after their emergence from these are known as post-ganglionic fibres. The ganglia and their associated fibres form a network which surrounds the blood-vessel as a part of its sheath and adventitious coat. Finally, these fibres penetrate the wall of the vessel and terminate in involuntary or non-striated muscle cells.

By means of their control of the muscular structure of the vessel wall, the sympathetic fibres act, under the effect of reflex stimuli, as dilators or constrictors of the arteries, arterioles and capillaries, and are, therefore, known as vasomotor nerves. Whether this action is an independent one or associated with central control, is a matter of controversy, but the anatomic arrangement of the pre-ganglionic fibres would suggest at least a correlated function with the brain and spinal cord.

Under normal physiologic conditions, a proper balance is maintained in the control of pulse-rate, blood-pressure and the volume of blood supplied to a given part. We are all familiar with the circulatory phenomena of shock, anger, and fear, and local anæmia and hyperæmia are under the control of this complicated vasomotor mechanism in which the sympathetic system plays a most important part.

Without opening up the entire field of speculation on the possibilities of surgery as related to disorders of the sympathetic system, it may not be out of place to recall that surgeons have attempted to correct disturbances of the form and function of various regions of the body, notably in the head and neck, by removal of sympathetic nerve ganglia. Based partially on the knowledge of the effects of irritation of the cervical ganglia of the sympathetic on pulse-rate and intraocular tension, Jonnesco, Jaboulay and others as early as 1889 removed one, two or all three of the cervical ganglia on one or both sides of the neck in cases of glaucoma and exophthalmic goiter. In Jacksonian epilepsy and tic douloureux, Jonnesco also employed the same method for the purpose of converting cerebral anæmia into hyperæmia, but as

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the effect of such modification of circulation is but a transitory one, the hypothesis does not hold good as a means of permanently relieving such conditions, and while a few cases were reported in which improvement or relief was apparent, as indicated by lessened intraocular tension, lowered pulse-rate, diminution in the size of the lobes of the thyroid and remission of pain in the cases of *tic douloureux*, the procedure has for the most part fallen into disuse and was abandoned as unsound and impractical.

The writer recalls one case during his internship in which G. R. Fowler excised the cervical ganglia of the sympathetic in the treatment of an advanced case of Graves' disease. The result was a disappointment, and no other similar case has since come under personal observation in which this method seemed justifiable.

In 1889, Jaboulay conceived the operation of periarterial sympathectomy and performed it with good results on the femoral artery in cases of perforating ulcer of the foot and to a less satisfactory degree on branches of the coeliac axis in certain visceral disorders in which the abdominal sympathetic system seemed to be at fault.

During the past twenty years little or nothing has been contributed to the literature in this field of surgery until Leriche, of France, a former pupil of Jaboulay, published a series of papers setting forth the results of his experimental work on the study of periarterial sympathetic phenomena. In 1921, Leriche presented the results of his research before the American Surgical Association. These observations were published in the *ANNALS OF SURGERY* in October, 1921, together with a most interesting account of his personal clinical experience in the application of this almost obsolete principle to the surgical treatment of certain pathologic and physiologic vasomotor disturbances of the extremities.

Leriche's experimental work verified and accentuated certain facts which in part were previously understood in relation to neurovascular phenomena and were briefly as follows: I. When the sheath of an artery is removed, the vessel begins to contract as soon as its external layer is pinched or traumatized; its pulsation lessens and its calibre diminishes. If the loose areolar tissue and adventitia are excised, the diminution in size will progressively increase, while the segments on either side of this area maintain their normal size if not injured. This contraction is the primary result of the normal reaction to excitation. It persists for several hours and is characterized by feeble pulsation of the vessel, coldness of the extremity, a blanched appearance of the skin and loss of function. These are the same phenomena which are present in the so-called syndrome of "*steupeur arterielle*" following trauma without gross injury to the vessel, but which, because of its close resemblance to gangrene, resulted in a number of unnecessary amputations during the war.

II. The secondary phenomena which occur several hours after excision of the sympathetics from the vessel wall are an elevation of local temperature of two or three degrees centigrade, a subjective sensation of heat, a local

rise in blood-pressure and evidences of a peripheral hyperæmia. The secondary reaction is transitory, becoming attenuated after five or six days, and disappearing after three or four weeks. These reactions are characteristic and according to Leriche, never fail if the resection of the tissues containing the nerve structure has been complete.

In applying the results of this experimental work to practice Leriche found it somewhat difficult to classify the vasomotor neuroses in which sympathectomy, so-called, might be applied, but he states that there are two large groups or types in which its application should be considered.

TYPE I. Active secondary spasm, or the so-called spastic anæmias, due to sudden or prolonged excitation of traumatic or toxic origin, as illustrated in the first instance by the above-mentioned "stupeur arterielle," and in the second, by Raynaud's disease, in which the symptoms are typical of vasomotor sympathetic disease. This group also includes the painful ischæmias and deformities which sometimes involve an entire limb, in which all of the vascular sympathetics are involved, as in cases of irritation or pressure from a cervical rib.

TYPE II. In this group there is a disturbance of physiological and biological function, in which the cause is not well known, but induced by prolonged contraction of the vessels or abnormally persistent dilatation. There are associated disturbances of motor, sensory, glandular and trophic origin, leading possibly to local necrosis, as illustrated by perforating ulcer of the foot. In this group are included the painful stumps and causalgias first described by Weir Mitchell, stiffness and contracture of muscles, as in Volkman's ischæmic paralysis, the intermittent claudication in certain forms of chronic arteritis or endarteritis obliterans and all forms of trophic ulcer.

Reasoning from the above analogy, Leriche was led to believe that the logical treatment of these vasomotor and trophic disturbances must aim to modify peripheral circulation by removal of the periarterial sympathetics.

The operation of sympathectomy was performed by him sixty-four times in causalgias, painful stumps, contractures following trauma, trophic ulcers, intermittent claudication, trophædema, frost bite, Raynaud's disease and several other conditions of neurovascular origin.

In the painful phenomena the results were extremely satisfactory except in painful stumps. It gave excellent results in two cases of Raynaud's disease, and in the trophic ulcers it was very efficacious. It did not prove satisfactory in frost bite or perforating ulcers, and was inferior to resection of neuromata followed by nerve grafting in the cases of painful stumps and trophic disturbances following section of a large nerve trunk.

The good results obtained are presumably due entirely to improved local circulatory activity, and the writer has long felt that if some method could be devised for producing a sustained improvement in local circulatory conditions it might be possible to solve many of our difficult surgical problems of the extremities in which disturbed or defective arterial circulation is a factor. This principle was recognized by Bier some years ago in advocating methods

for the production of passive hyperæmia by mechanical means, a measure which proved helpful as an adjunct in the treatment of a variety of chronic lesions of bones, joints and soft parts.

While interested in Leriche's work, I recalled a patient who had been under our observation in the Surgical Clinic of the Brooklyn Hospital for several years with an ulcer of an amputation stump which had persisted in spite of a prolonged period of surgical treatment and observation.

CASE REPORT

F. Y., male, aged thirty, had an amputation of the right leg twenty years ago. The amputation followed a severe traumatism and was done about four inches below the knee-joint. The stump never healed satisfactorily, and although the patient wore an artificial leg and was able to get around, he was constantly returning to hospitals and dispensaries because of the unhealed stump. The artificial peg-leg was correctly fitted and in no way produced pressure; when left off for prolonged periods, the ulcer showed no tendency to heal. Eight years ago the stump was revised at operation, but the wound again broke down. In November, 1921, he complained that the stump was cold and gave him constant pain. He was sent to the hospital for observation, and at that time we did a plastic resection of the scar, excised the bulbous nerve end and resutured the muscle and fascial planes. Great care was used in the approximation of healthy skin flaps. This was followed promptly by a failure to heal and the reformation of two good-sized ulcers which were continuously painful and had a deep, indolent, sloughing base. The sensation of coldness persisted and the surrounding skin remained blue. Two months later he again entered the hospital because of constant pain and annoyance from the unhealed ulcers. With Leriche's work in mind, the operation of periarterial sympathectomy was proposed and accepted by the patient after all other measures had failed to produce relief.

The popliteal artery of the affected leg was exposed along the outer border of the semimembranosus tendon and isolated for a distance of eight or nine centimetres by means of two traction sutures passed around the vessel above and below. In this way it was held free of the surrounding structures. With mouse-tooth forceps and a straight-bladed knife, the sheath of the artery was first dissected away from the freed portion of the vessel and then by further dissection and a shaving process the loose areolar tissue and adventitia were removed, leaving the muscular wall of the vessel bared. The phenomena of immediate contraction was present. The operation was completed in the manner described by Leriche and the wound was closed. The stump and ulcers were left undisturbed. On the day following there was complete relief from pain, which up to the time of operation had been constant and most annoying. There was an increase in local heat and peripheral hyperæmia. Both ulcers, which had previously resisted all efforts to promote healing, within a week became superficial and assumed a healthy red appearance, following which epithelialization was rapid and continuous.

It is now one year since this patient left the hospital, during which period he has been seen and examined at regular intervals. He has remained entirely free from pain, and there has been no evidence of ulcer reformation. The skin covering the stump still remains somewhat bluish in color and cold in comparison with the surface temperature of other parts of the body.

Since operating on this patient, five other patients in the surgical wards of the Brooklyn Hospital have been subjected to periarterial decortication. Two of these occurred in the service of the writer and three in the

service of Dr. J. E. Jennings. All five of these were cases of endarteritis obliterans with impending or actual gangrene of varying degrees. The operation was attempted in each instance merely as a palliative measure for the relief of intolerable pain. In three cases the relief was immediate and added much to the comfort and happiness of the patients for considerable periods of time or until amputation was indicated or necessary. In one case the operation was a failure because of the brittle character and consequent accidental wounding of the vessel. This made necessary an immediate amputation, which, although contemplated, we hoped to postpone until observations had been made on the degree of palliative relief obtained. In the fifth case relief from pain was not so marked, but temporary only. In this instance the result could not be looked upon as satisfactory.

Recent contributions to the literature by Callander, Lehman, A. E. Halsted and others, while expressing a wide difference of opinion on the correctness of the principles involved and the value of the operative procedure as a means of relief in the conditions mentioned, would, nevertheless, indicate an increasing interest and clinical experience in the application of surgery for the relief of vasomotor disturbances in which the sympathetic ganglia seem to play an important part.

To those of us who had followed the course of the patient above reported in detail, the outcome was both unexpected and gratifying. Our limited experience taken in conjunction with the much larger clinical opportunities of Leriche, would seem to open up a rather wide field for experimental work and further study in a large group of cases which in the past have been both troublesome and discouraging in the application of medical and surgical resourcefulness.

In many of the painful and intractable lesions of the extremities, including some of the neuritides, in Raynaud's disease and in trophic ulcers, as well as other chronic lesions in which inadequate peripheral circulation seems to be a factor, I should not hesitate to consider removal of the arterial sympathetic ganglia as a possible means of palliation or relief.

The operation may be done simply and with little or no detriment to the patient. It seems, therefore, to offer possibilities which are well worth our time and consideration.

ANTHRAX AND ITS TREATMENT

By HAROLD E. SANTEE, M.D.

OF NEW YORK, N. Y.

SINCE 1915, when Eichhorn in this country first made available through the Bureau of Animal Industry in Washington a specific serum therapy for human anthrax, the treatment of this condition has gradually been revolutionized. Evolution in therapy, however, has been slow as a result of the fact that few institutions in this country are called upon to treat this disease with much frequency. At Bellevue Hospital where the Isolation Service receives these patients from the Borough of Manhattan, there have appeared since the beginning of 1915, forty cases in which the clinical diagnosis of anthrax has been made from the characteristic appearance of the primary focus and in which laboratory confirmation of such diagnosis has been obtainable in almost all. During this time, treatment has gradually changed from supportive and surgical through the stages of surgery combined with serum until now it is the general feeling of those who come in contact with this disease in the form of malignant pustule that surgery as such has no place in the treatment of this lesion; that its use may be directly harmful in the dissemination of the infection, in that complete removal of the infection is practically impossible by such means; that serum therapy presents the best prospect of a cure.

A brief resumé of the cases since 1915 is presented through the courtesy of Doctors Hooker, Hartwell, Stewart and Smith, the directors of the four surgical divisions who assume responsibility for the outside service in rotating periods of six weeks each. Only eight of these cases have been observed personally.

In a review of the above cases certain points may well be emphasized on both the clinical and therapeutic sides. Etiologically the number of cases directly traceable to the use of new shaving brushes has already been pointed out.¹ As a rule these brushes have been of the cheapest variety. Control and limitations upon the use of horse hair without previous sterilization in the manufacture of such brushes have now been made sufficiently strong so that the incidence of the disease from this source should be largely eliminated.² The site of the lesion in practically all of these cases was face or neck, the lesion itself in a striking number of cases, as determined by history, taking thirty-six to forty-eight hours to develop to the stage where medical advice was sought. At this time its clinical appearance was very characteristic in the vast majority of cases, with blackish dry central eschar slightly depressed below the surrounding zone of superficial redness on which show more or less numerous small vesicles with clear content, this zone changing abruptly to normal or glossy looking skin outside, the entire lesion

and surrounding tissues being the site of an œdema that is huge and extensive in the elapsed time. Striking are the absence of pus, the absence of much pain or tenderness, the non-pitting or semi-solidity of this huge œdema, and in most of these cases the absence of enlargement of the draining nodes. In these cases, probably due to the site of the lesion, associated dysphagia and respiratory embarrassment have been fairly frequent. However, œdema of the pharynx and glottis have been soft and in one case multiple incisions through mucous membrane at this site seemed a life-saving measure.

The period from forty-eight to ninety-six hours seems to be the time in which a septicæmia is most apt to develop. No evident clinical signs or symptoms make the onset of this septicæmia apparent. Hence the importance of a blood culture at the time of admission together with direct smears or cultures from the lesion should be emphasized. That this septicæmia makes the disease a rapidly fatal one is evident from the fact that nine of the above fourteen fatal cases died within twenty-four hours after admission and seven of these within twelve hours. In eight of these fourteen cases the septicæmia was proved by culture. In the remaining six death occurred in the same manner without complicating conditions which could be considered as directly causative.

Temperature reaction in these cases in which death supervened gave no indication of prognostic or diagnostic importance. It varied in proved septicæmic cases from 98° to 106°; the very low temperatures, however, usually occurring in those individuals who were very toxic on admission or in a condition bordering on collapse. In five septicæmic individuals where blood counts were made, a leucocytosis varying from 14,000 to 39,000 was encountered, a polynucleosis varying from 83 per cent. to 92 per cent. The leucocytosis in these cases seemed to increase as the septicæmia increased. Several autopsy reports showed in addition to the septicæmia an œdema of the superficial and deep tissues of the body, a pial œdema or congestion with the formation of small hemorrhagic foci, hemorrhagic foci in the small intestine or mesentery, and hydrothorax, hydro-pericardium or hydro-peritoneum, such fluid being at times blood tinged.

An analysis of the above cases for therapeutic indications shows certain striking facts. Prior to 1920, when intensive treatment with serum was begun, twenty-one cases were admitted with eleven deaths (52.4 per cent.), three of these deaths occurring so quickly that no operative or serum therapy was used. Of the remaining eighteen cases with eight deaths (44.4 per cent.), fourteen were treated by excision plus antiseptics plus serum with four deaths (28.5 per cent.), two of these being septicæmias on admission; four were treated by serum alone, four died, three receiving a single dose intravenously of approximately 40 c.c. before death; the fourth receiving 40 c.c. daily for five days and dying on the fifth day. This last case was from the standpoint of serum therapy unfortunate in that it was the first case on which serum alone was used (in 1915) and the result was discourag-

TABLE I.
THIRTY-SEVEN CASES TREATED BY SERUM.

Case No.	Age	Occupation	Etiology	Day of disease	Site of lesion	Direct		Blood Culture	Gen. con- di- tion	Oper- ative	Antiseptic	Intravenous c.c. in days.					Local c.c. in days.					Result	Remarks.
						Smears	Culture					1	2	3	4	5	1	2	3	4	5		
1	52	Hides	Abrasion	?	Chest	+	+	+	Poor													Died	Death in thirty-six hours.
2	72	Lawyer	?	2	Neck	+	+	+	Fair			40	45	40	40	40						Died	Death on fifth day.
3	17	Candy packer	?	?	Chest	+	+	+	Poor			40										Died	Death in eleven hours.
4	39	Hides	Abrasion	2	Hand	+	+		Good	Excised	Phenol	45	30			12				40	50	Cured	
5	37	Gardener	?	4	Cheek Neck				Poor			10	25	50								Died	Death in forty-eight hours.
6	54	Longshore-man	Hides	2	Neck	+	+	+	Good	Excised	Serum	50	100									Cured	
7	36	Longshore-man	?	4	Neck				Poor	Excised												Died	Death in twenty-four hours.
8	28	Peddler	?	?	Cheek	+	+	+	Bad													Died	Death in five hours.
9	30	Longshore-man	?	3	Neck	+	+		Bad			100										Died	Death in nineteen hours.
10	57	Longshore-man	?	4	Neck	+	+		Good	Excised	Bichloride	25	45	45	45	45						Cured	
11	26	Longshore-man	?	2	Neck				Good	Excised	Dichloro-amine-T	50	50	50	50	50						Cured	
12	41	Laborer	?	4	Neck	+	+	+	Bad	Excised	Phenol	45	45									Died	Death in thirty-two hours.
13	30	Hides	Shaving	3	Cheek	+	+	+	Fair	Excised	Phenol	90	90	225								Died	Death on fourth day.
14	35	Laborer	?	3	Cheek	+	+	0	Good	Excised	Phenol	45										Cured	
15	19	Necttie maker	?	4	Cheek	+	+	+	Good	Excised	Phenol	10	10	10	10	10						Cured	
16		Concrete mixer	Shaving brush	3	Neck	+	+		Good	Excised		10	10	10	10	10						Cured	Received ten c.c. for nine days.
17	32	Waiter	Shaving brush	2	Cheek	+	+		Good	Excised	Chinosol	20	20	20	20	20						Cured	Received twenty c.c. for six days.
18	46	Fireman	Shaving brush	2 (?)	Cheek Hand	+	+		Bad													Died	Death shortly after admission.

ANTHRAX AND ITS TREATMENT

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NOTE.—Three cases omitted because of incomplete records.

ing. In the light of later experience, perhaps the time elapsed before death should have been encouraging rather than otherwise.

In 1920, the use of serum intensively was begun, accompanied by no operative interference. Of the sixteen cases admitted since this time, three died (18.7 per cent.), all within $7\frac{1}{2}$ hours of admission (4, 5, $7\frac{1}{2}$ hours). All of the three were septicæmias on admission. Of the thirteen cured, one was septicæmic on admission.³ In these thirteen cases the records of three show the use of local serum injections only, two receiving 10 c.c. every four hours for five days, one receiving 10 c.c. each day for three days. That this type of local specific therapy may be used to advantage seems borne out by the observation of Marchoux⁴ that it facilitates phagocytosis and by the experience of Regan⁵ in his excellent report of seven cases so treated. All other cases have been treated by combining intravenous with local serum injections. The routine has been to give 40 c.c. intravenously and 10 c.c. locally every four hours, treatment being started on diagnosis and coincident with the initial blood culture. A desensitizing dose preceded all injections. Our inclination now is to consider every case a septicæmia at the outset and to give one or two massive doses intravenously until blood culture proves definitely negative (twenty-four hours). Treatment should be intensive at the outset, gradually diminishing after forty-eight hours or on negative culture, rather than the opposite. Serum reactions have been present in practically all cases whether serum dosage was small or large; in no case was serum thought to be related to a fatal termination.

Regarding operation on the lesion in these cases, it seems fair to assert that surgery has no place here if serum is available. In fact it is open to grave question whether it has any place in this disease even without available serum. It has been shown by His and Zinsser⁶ that immediate excision of the site of inoculation in guinea pigs fails to check the spread of the infection; abundant statistics are available to show a higher mortality with the use of surgery than without. That this conclusion conforms to the pathological conditions as well is borne out by the observations of the pathologists that the swelling in these cases is due to the presence of a semigelatinous substance, anthraco-mucin, which is inimical to the growth of the anthrax bacillus and which represents, therefore, a defense reaction on the part of the tissues, and should be left alone.⁷

Symmers, as a result of considerable experience with the serum treatment of anthrax in human beings, believes that every such lesion of the skin or elsewhere should be tentatively regarded as attended by generalized infection, until the result of the blood culture proves the contrary, and that in no circumstances is it justifiable to incise, excise, cauterize or otherwise tamper with the anthrax pustule, since septicæmia may result. According to this observer, the most dependable routine method in the treatment of the anthrax pustule is, first, to isolate it within a barrier of anti-anthrax serum subcutaneously injected every four hours; second, to inject intravenously at once a sterilizing dose of 150 or 200 c.c. of serum, and, third, to supplement this

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by the intravenous injection of 40 c.c. every four hours. If the blood culture is negative at the end of twenty-four hours, the intravenous use of serum is discontinued, the local injections being kept up until the pustule is free from bacilli or at least until involution forms occur in the stained films. In anthrax septicæmia, the same routine is followed until the blood cultures are negative or until death supervenes.⁸

SUMMARY

Thirty-seven cases of anthrax are reviewed.

This disease tends toward a septicæmia from the local lesion.

Specific serum offers a very fair prognosis.

Its use should be intensive, both intravenous and local, at the outset.

Surgery has no place in the treatment of the lesion. Its use may be directly harmful.

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³ Symmers, D.: ANNALS OF SURGERY, June, 1922, p. 663.

⁴ Marchoux, E.: Serum Anti Charbonneux, Annales de l'Institute Pasteur, November, 1895, p. 800.

⁵ Regan, J. C.: Amer. Jour. of Med. Sciences, September, 1921, p. 406.

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THE OPERATIVE CURABILITY OF CARCINOMA OF THE STOMACH*

By DAVID CHEEVER, M.D.

OF BOSTON, MASS.

FROM THE SURGICAL CLINIC OF THE PETER BENT BRIGHAM HOSPITAL, BOSTON

A LESION which comprises about one-third of all instances of carcinoma, and which hitherto has been so insusceptible of successful treatment that it has been generally regarded by the medical and lay public as nearly hopeless, certainly deserves the most earnest study, in an endeavor to improve our results. Such a lesion is carcinoma of the stomach. While there is some variation in the reports from different clinics, it seems to be a conservative statement that taking into consideration both its frequency and its obstinacy, it is the chief single contributor to the total cancer mortality.

There appears to be no inherent reason why carcinoma of the stomach should present such a problem. Its natural history is presumably similar to that of carcinoma elsewhere. Disregarding for a moment its etiology we may say in accordance with prevailing views that its original focus is a cell or group of cells endowed with the fatal property of atypical and unregulated division and growth; that it increases at first by invasion of the tissues of the stomach itself, or of neighboring and adherent organs, and that at some variable and not to be predicted time, it further disseminates itself by cellular emboli in the lymph or venous blood streams. A fourth method of spread can only be possible in a hollow organ which lies free in a body cavity; namely, the breaking off of small cell masses from the parent growth and their implantation either at another point of the mucous membrane within the stomach or at various points in the peritoneal cavity outside the organ. If these accepted views are correct, surgical removal of the focus while still localized will cure the disease.

Anatomical and physiological considerations offer every encouragement to the belief that extirpation is possible. The stomach is accessible to attack, and especially the part between the incisura and the pylorus where, according to Welch's classical analysis of 1300 cases, about 70 per cent. of the lesions occur. The first relay of nodes receiving the lymph stream from this region lie along the borders of the viscus, between the layers of the gastro-hepatic and gastro-colic omenta, respectively, and are thus susceptible of removal. The blood supply is very rich, and there is a free intramural anastomosis between the lesser arterioles, so that the most extensive resection and elaborate restorative suturing can be carried out without fear of devitalizing what remains of the organ, a condition which contrasts sharply with the small intestine. The union of the proximal part of the stomach with the jejunum may be technically more or less difficult, depending on the extent of the resection, the adiposity of the patient and other factors, but it may usually be accomplished satisfactorily. The loss of the function of the stomach furnishes no insuper-

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able obstacle to operation. Here as in so many other instances Nature has been lavish in bestowing an excess margin of physiological efficiency, so that a large part or even the whole of the stomach may be sacrificed without seriously affecting the digestive function. Subtotal gastrectomy is commonly performed, and there are enough instances of the maintenance of health after a practically complete removal of the organ to justify the surgeon in being as radical as is made necessary by the extent of the lesion. The well-recognized rule that when one member of a physiologically related group of organs gradually becomes crippled by disease the other members may assume compensatory increase of efficiency is applicable here, for in some slowly developing forms of carcinoma, such as the scirrhus or "leather bottle" type, the stomach may be reduced to a mere tubular canal along which the food passes rapidly through a gaping pylorus, without the delay necessary for the exercise of the chemical or motor functions of the organ, which indeed have been destroyed by the disease. Such a patient may maintain a surprising degree of health, and the successful removal of the greater part of such a stomach may not affect seriously the digestive processes.

If these facts are admitted, why have the results of radical operation been so generally unsatisfactory? Perhaps it is because the disease is disseminated from the original focus at an earlier period than is the case with carcinoma in other situations. But the opinion that the disease may remain local for a long time seems to be justified by review of the history of certain cases which have come to operation or autopsy, and other cases where exceptional circumstances have given opportunity to follow the natural history of the disease. Two forms of dissemination will admittedly render a case incurable; that is implantations in the peritoneal cavity in cases where the disease has penetrated the visceral wall, and metastases to the liver by way of the portal blood stream. The first form can necessarily occur only in the comparatively late stages of the disease. Table I shows the incidence of metastases to the liver in cases occurring at the Peter Bent Brigham Hospital. Inasmuch as among the 67

TABLE I

Incidence of Metastases to the Liver in Carcinoma of the Stomach.

Among 67 operative cases, in which the condition of the liver could be observed, there were:

Metastases present in 15, or 22.3 per cent.

Metastases absent in 52, or 77.7 per cent.

Among 22 non-operative cases coming to autopsy, the liver showed:

Metastases present in 17, or 77.2 per cent.

Metastases absent in 5, or 22.8 per cent.

operative cases in this table, in only 23 could a radical operation be performed, in 29 of the remaining, or 43.2 per cent., the obstacle to such an attempt was not metastases in the liver, but rather the local extent of the disease or of its lymphatic dissemination. It is striking to note also that in cases which have died of carcinoma of the stomach, the liver was still not involved in 22.8 per cent.

The inevitable deduction from the foregoing considerations seems to be that the most formidable obstacle to success in the surgical treatment of carcinoma of the stomach lies in the delay of the patient in seeking surgical aid, and it is the common experience that this delay is occasioned by the insidious, stealthy course of the disease. Unless it begins close to the cardiac or pyloric orifice and thus interferes promptly with the entrance or exit of food, we cannot expect early symptoms. The great zone between these points may be designated as a silent area, where the lesion may exist and progress locally, gradually interfering with the chemical and motor functions, but so slowly as to permit of abundant compensation elsewhere. Striking symptoms, such as vomiting of blood or the passage of tarry stools, are late rather than early. Pain, which is frequently the first symptom complained of, does not characterize the growth of the tumor itself. The stomach does not possess nerves which respond to ordinary pain stimuli. It may be bruised, cut or cauterized in the non-anæsthetized patient without a sensation of pain, and it is presumably not until the progress of the disease causes adhesions to neighboring structures, or by interfering with the emptying of the organ increases intragastric tension during peristaltic tonus, that painful sensations result.

When the cause of a disease is well understood, a long step has been taken towards establishing an early diagnosis. The cause of carcinoma of the stomach is not yet known. The usually suggested factors apply here as elsewhere, such as foetal rests, physical, chemical or thermal trauma and chronic irritation. It is the relation between chronic ulcer and carcinoma which is at present exciting most interest and discussion. That chronic gastric ulcer should undergo malignant metamorphosis is quite in accord with the behavior of similar lesions elsewhere. The most familiar and unquestioned examples of such a change are the epithelioma of the lower lip from irritation of the hot pipe stem, and of the tongue from the injury due to ragged and decayed teeth, or the malignant degeneration of chronic ulcer of the lacerated cervix uteri, or of varicose ulcer of the leg. The Rochester, Minnesota, School believe that they have shown carcinoma developing in the edge of a chronic ulcer in a large proportion of cases, and state that 60 per cent. of the operatively proved cases give an ulcer history. Smithies reduces the figure to 54 per cent., Graham to 40 per cent., and Friedenwald to 23 per cent. This view is widely held, but equally competent observers hold contrary views. For instance, Ewing states that it is his opinion that carcinoma is grafted on ulcer in about 2 to 3 per cent. of cases. The conflict of opinion on pathological evidence seems to depend on personal equation in the interpretation of the histological picture. The fact is that every chronic ulcer shows grossly a peripheral thickening and induration which suggests neoplasm, and microscopically, regeneration of glandular alveoli which may be so distorted and misplaced as to suggest malignant metamorphosis, while every carcinoma, as soon as its growth has outstripped its blood supply, necessarily ulcerates at the centre and presents a picture which may in some cases be confused, both grossly and microscopically, with ulcer.

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The records of all cases of gastric carcinoma admitted to the Peter Bent Brigham Hospital in the ten years, 1913-1922, inclusive, have been examined with the idea of determining the actual outcome of treatment, and of studying the various factors which may lead to earlier diagnosis and more favorable results. Naturally, in only those cases which come to operation or autopsy could the diagnosis be certified. In most others the criteria for a positive diagnosis rested on a positive history, a mass in the epigastrium and a characteristic filling defect on röntgenological examination. In a few cases the absence of one of these was permitted, if other minor features were present, such as achlorhydria, hæmatemesis or evidence of blood in the stools. Any case affording reasonable doubt of the diagnosis was rejected. Lymphosarcoma and similar types of malignant disease have not been included.

TABLE II
Analysis of 236 Cases of Carcinoma of the Stomach.

<i>Sex Incidence.</i>		
Sex	No. of cases	Per cent.
Male.....	157	66.5
Female.....	179	33.5

<i>Age Incidence.</i>		
Age	No. of cases	Per cent.
21-30 incl.....	2	0.8
31-40 incl.....	20	8.4
41-50 incl.....	58	24.5
51-60 incl.....	84	35.5
61-70 incl.....	60	25.4
71-80 incl.....	12	5.0

TABLE III
Analysis of Symptoms First Complained of in 223 Cases of Carcinoma of the Stomach.

Symptoms	No. of cases	Per cent.
Epigastric pain.....	57	25.5
Epigastric distress after eating.....	43	19.2
Belching of gas.....	25	11.2
Weakness and debility.....	25	11.2
Loss of appetite.....	21	9.4
Nausea or vomiting.....	19	8.5
General abdominal pain.....	8	3.6
Loss of weight.....	4	1.7
Sour stomach.....	4	1.7
Constipation.....	4	1.7
Dysphagia.....	4	1.7
Pallor.....	3	1.3
Backache.....	3	1.3
Mass in epigastrium.....	2	0.8
Vomiting of blood.....	1	0.4

During this decade, 236 cases were found conforming to the above requirements. Table II gives the age and sex incidence. The preponderance of men over women is more striking than in most statistics. It illustrates also the well known fact that the diagnosis of carcinoma of the stomach must be

considered in patients under thirty, and is common between thirty and forty. Table III presents an analysis of the symptoms first complained of by the patient in 223 cases in which the history was satisfactory in this respect. It is quite in accord with general experience and presents nothing new, but deserves attention because only when it is realized by the laity and by the general practitioner that such symptoms are significant until proven otherwise may we expect to be consulted in time to operate with reasonable prospect of cure. It is worth noting that weakness and debility, general abdominal pain, loss of weight, constipation, pallor, and backache together constitute the initial symptoms in 20.8 per cent. of the cases, and if we add the 9.4 per cent. of patients complaining at first only of such a universal symptom as loss of appetite, we find that in 30 per cent. of the cases the earlier symptoms would not be likely to suggest to the patient that the stomach was the source.

TABLE IV
Analysis of Symptoms.

<i>Incidence of Vomiting before Admission in 225 Cases.</i>		
Vomiting occurred in	153 cases,	or 68 per cent.
No vomiting occurred in	72 cases,	or 32 per cent.
Blood or coffee grounds noted in	48 of 153 cases,	or 32.1 per cent.
No blood or coffee grounds noted in	104 of 153 cases,	or 67.9 per cent.
Forty-eight patients out of 225, or 21.3 per cent., complained of bloody or coffee grounds vomitus.		

Incidence of Blood in Stools before Admission.

Tarry stools noted in 26 cases out of 236 cases,	or 11 per cent.
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Vomiting is a symptom so objective and annoying that it is likely to be taken seriously by the patient, especially if the vomitus contains blood or such a peculiar looking substance as "coffee grounds," which resembles nothing that the patient has eaten. Table IV shows that although, as will be seen later, the type of cases admitted was so advanced that less than 10 per cent. could be subjected to radical operation, nevertheless 32 per cent. had had no vomiting whatever before admission, and among the cases which had vomited, only 32.1 per cent. had noted anything so unusual as blood or coffee grounds. Among the laity the impression is widely held that the vomiting of blood is necessary for a diagnosis of cancer of the stomach. Let it be noted then that in this series but 21.3 per cent. had had bloody or coffee grounds vomitus previous to admission. Tarry stools were noted in so few instances, 11 per cent., as not to constitute an important factor in early diagnosis.

Table V shows the duration of symptoms before admission. It should be read with two facts in mind; first, that the great majority of patients admitted showed the disease in too advanced a form to permit of radical operation, and second, that while the exact duration of a case of carcinoma of the stomach can never be known, there is plenty of direct evidence that in many cases the life history may be 5, 6, 7 years or more. Table V shows that 50 per cent. of the cases had had symptoms for only 6 months, and 80 per cent. for less than 1 year. In other words, if 80 per cent. of the patients presented

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themselves at the very onset of symptoms and were at once successfully diagnosed, it is probable that only a small proportion would be found to be radically operable.

TABLE V

Duration of Symptoms Before Admission in 220 Cases.

Time	No. of cases	Per cent.
Less than 2 wks.....	2	0.9
2 wks.-1 mo.....	5	2.3
1-2 mos.....	24	10.9
2-4 mos.....	52	23.6
4-6 mos.....	28	12.6
6-12 mos.....	65	29.5
12-18 mos.....	12	5.5
18-24 mos.....	21	9.5
2-2½ yrs.....	4	1.8
2½-3 yrs.....	5	2.3
More than 3 yrs.....	2	0.9

TABLE VI

Duration of Life in 97 Inoperable Cases Traced (Omitting Operative Fatalities).

Time	No. of cases	Per cent.
1 wk. or less.....	15	15.2
1-2 wks.....	13	13.2
2-4 wks.....	16	16.4
1-2 mos.....	14	14.4
2-4 mos.....	19	19.5
4 mos. or more.....	20	20.6

44.8 per cent. of this group lived 1 mo. or less
9.2 per cent. of this group lived 6 mos.

TABLE VII

Length of Life from Onset of Symptoms to Death in 83 Cases not Operated on.

Time	No. of cases	Per cent.
2 months or less.....	8	9.6
2-6 months.....	23	27.7
6-12 months.....	11	13.2
12-18 months.....	23	27.7
18 months or more.....	18	21.6

The standard of operability, in different clinics and in the hands of different surgeons, must vary to a certain extent, and the accurate comparison of statistics is therefore fallacious. Tables VI and VII will seem familiar to surgeons whose clinical material is drawn from large cities on the seaboard, where the large proportion of recent immigrants and the congestion of population make the level of intelligence relatively low. Table VI shows the duration of life from admission to the hospital in such cases as were considered inoperable and could be followed up. Cases explored and found inoperable were not included in order to eliminate the factor of operative trauma. It will

be seen that 44.8 per cent. lived less than one month, and only 9.2 per cent. lived 6 months or more. There can be no difference of opinion as to the inoperability of these cases. Table VII gives evidence on the same point, and also shows the extraordinary insidiousness of the disease. It shows that among 83 cases not operated on the total elapsed time from the onset of symptoms to death was, in nearly 40 per cent. of the cases, only 6 months or less. And this in a disease whose average duration is probably 4 years!

TABLE VIII
Relation of Ulcer to Carcinoma of the Stomach.

Ulcer history	No. of cases	Per cent.
Positive.....	18	7.6
Plausible.....	14	5.9
Possible.....	20	8.4
None.....	184	77.9

Pathological examination was reported to show carcinoma developing on ulcer in 4 cases in 46 cases coming to operation or autopsy, or 8.7 per cent.

The relation of a history of ulcer to carcinoma in the total of 236 cases appears in Table VIII. Here obviously the bias and judgment of the investigator must play a rôle. The types of histories classified under the heading "positive," "plausible," "possible," and "none" are indicated satisfactorily by these words. A patient who described in his antecedent history any symptoms however trivial which might be associated with gastric digestion was placed in the "possible" group, and only those who categorically denied abdominal pain, distress, indigestion, nausea, vomiting or belching of gas were considered to have no ulcer history. Certain cases giving a gastric history somewhat suggestive of ulcer of 3 years' duration which were found at operation to present an advanced carcinoma were considered to have been malignant from the beginning, because in the judgment of the operator the growth was consistent with that period of development. Under this classification, 7.6 per cent. were unequivocally positive. The two intermediate doubtful groups may doubtless be assigned according to the bias of the individual investigator. A bit of evidence from a different source exists in the report of the pathologist of carcinoma developing on ulcer in 4 instances among 46 cases which came to operation or autopsy; an occurrence percentage of 8.7, which corresponds rather strikingly to the 7.6 per cent. of positive ulcer histories. The relation between the presence of free hydrochloric acid and a history of ulcer does not appear intrinsically important. Seventy-three and nine-tenths per cent. of the cases showed achlorhydria; and of the remaining 26.1 per cent. showing the presence of hydrochloric acid, 13.9 per cent. gave a positive antecedent ulcer history.

In presenting a statement of the operability of the 236 cases under consideration, it is realized that there can be no just measure of its accuracy or fallibility. No two surgeons are alike in their judgment as to operability or

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their skill in operating. Table IX represents the judgment of a small group of surgeons whose aim is not to permit the ideal of a low operative mortality to withhold from a patient any reasonable hope of cure. Table IX shows that 62.6 per cent. of all cases admitted had to be denied any possible hope of palliation or cure, while in only 9.7 per cent. was it considered feasible to attempt a radical operation. Among the 5 per cent. who refused treatment

TABLE IX
Analysis of Operability of 236 Cases.

Treatment	No. of cases	Per cent.
Inoperable for either exploration, palliation, or cure.....	124	52.5
Explored and found inoperable for either palliation or cure...	24	10.1
Palliative operation for obstruction or perforation.....	53	22.4
Radical operation.....	23	9.7
Operation refused.....	12	5.0

TABLE X
Operative Mortality in 100 Cases.

Operation	No. of cases	No. of deaths.	Mortality per cent.
Exploration only.....	24	5	20.8
Palliative operation for obstruction or perforation.....	53	7	13.2
Radical operation.....	23	3	13.0

were a few who on exploration might have been added to this group. Two patients are remembered who suffered a possible miscarriage of treatment, which resulted in a palliative rather than any attempt at a radical procedure. Making due allowance for these instances, it seems to be a fair statement that in about 10 per cent. of all cases admitted to the hospital a radical cure could be attempted.

In Table X is tabulated the mortality in 100 cases subjected to some form of operation. Simple exploration showed the high mortality of 20 per cent., for which no apology is made. These cases were all obviously radically inoperable; the exploration was in most cases done under novocain anæsthesia with the idea of palliating the suffering of the terminal stage of the disease. The expediency of exploring will depend on the temperament and point of view of the surgeon and his patient. The latter is in a pitiable condition, regurgitating the liquids he tries to take to quench his thirst, dehydrated, kept alive by daily subcutaneous saline infusions and rectal alimentation. He may grasp at the possibility of relief for a few weeks by a simple palliation, at the expense of a high risk of more speedy termination of his suffering. The surgeon need not reproach himself if he is the agent of this relief, in whatever way it may come. The palliative operations for obstruction or perforation and the radical gastrectomies carried nearly the same mortality, about 13 per cent.

TABLE XI
Analysis of Operative Results.

<i>Palliative Operations In 30 Cases Traced.</i>		
Lived	No. of cases	Per cent.
Less than 1 mo.....	1	3.3
More than 4 mos.....	22	73.3

<i>Radical Operations In 20 Cases, All Traced.</i>		
Lived	No. of cases	Per cent.
Less than 12 mos.....	4	20.0
1-1 ½ yrs.....	6	30.0
2 ¼-4 yrs.....	2	10.0
7 yrs.....	1	5.0
Still Living.....	7	35.0

Of the Seven Patients Still Living,

1 is alive at the end of 1 yr.
 1 is alive at the end of 1 ½ yrs.
 1 is alive at the end of 3 yrs.
 1 is alive at the end of 4 yrs., 11 mos.
 1 is alive at the end of 5 yrs., 10 mos.
 1 is alive at the end of 6 yrs., 6 mos.
 1 is alive at the end of 7 yrs., 9 mos.

Thus three cases, or 13.0 per cent. of operable cases, or 1.2 per cent. of all cases seen, show 5 year "cures."

Here are analyzed the end results of the palliative and radical operations. In regard to the former procedures, comparison may be made with Table VI, where it was shown that of patients not operated on 20.6 per cent. lived 4 months or more, while 73.3 per cent. of the patients afforded palliative operations lived a similar period. The two series are not exactly comparable, as the non-operated cases were on the average more advanced, but when considered also with reference to the relief afforded by gastro-enterostomy, it appears that attempts at palliation are abundantly justified.

In the case of the radical operations, it is fortunate that all have been traced. They are arranged in two groups, those who have died and those still living. The tabulation shows 13 per cent. of the radically operable cases living at the end of 5 years without evidence of recurrence; which is equivalent to 1.2 per cent. of all cases of carcinoma of the stomach seen at the Brigham Hospital. Another patient, living at the end of 4 years and 11 months, when this paper is written, may justly be included. Yet another, who lived 7 years, developing an apparently independent cancer of the breast and dying of spinal metastases without known local recurrence of the carcinoma of the stomach, would, if included, still further improve the statistics.

Such a record of failure to cure the most common type of malignant disease is regrettable, but the most discouraging feature is that it is difficult to see how any very great improvement may be achieved. Early diagnosis and prompt resort to surgery appear to be at present the only key to success, but if the

disease in most instances runs the greater part of its course so insidiously that the patient is quite oblivious of it, and if the first symptoms are apt to be so trivial as not to attract serious attention, it is unlikely that rapid progress can be made. It is desirable that both physicians and patients should pay less regard to the text-book picture of the disease in its fully developed stages, and should realize that any obscure symptom complex, however trivial, especially if it involves any change in the previous digestive habit of the individual, must be investigated and proved to have no malignant basis. Of methods of diagnosis, undoubtedly the most accurate by a wide margin are fluoroscopy and radiography after the ingestion of the opaque meal. In the series under consideration, 93 per cent. showed a pathognomonic picture leading to correct diagnosis, 3.5 per cent. were suggestive, and in only 3.5 per cent. was a negative report made. This period included the war, when owing to a changing and depleted staff, the work was not always satisfactory. It is likely that in experienced hands in the future an accurate positive diagnosis will be made in at least 97 per cent. of the cases.

Carcinoma of the stomach is curable by radical surgical operation, at the expense of a high but justifiable mortality. Success depends, as in most surgical conditions, on early diagnosis and prompt recourse to treatment.

ACUTE PERFORATION OF DUODENAL ULCER

BY HAROLD KOCH SHAWAN, M.D.

AND

C. FREMONT VALE, M.D.

OF DETROIT, MICH.

THE following report is based on ten consecutive cases of acute perforation of duodenal ulcers, admitted to the Receiving Hospital of Detroit during the past two years. Reference to cases of subacute and chronic perforation is purposely omitted. We shall give a résumé of the history, examination, operative finding, immediate outcome, and will, of necessity, defer including the ultimate result.

Of the ten cases, nine were male and one was female. Their occupations were given as laborer (2), not employed (2), farmer (1), housewife (1), engineer (1), clerk (1), miner (1), watchman (1); in nationality, American (5), Scotch (3), Irish (1), Hebrew (1). The average age was thirty-eight and one-half years; the oldest being fifty-six, and the youngest nineteen.

Six cases had a typical history of chronic ulcer, the average duration of which was seven years. Two gave indefinite reports of recent indigestion, of five and seven days, respectively. Two presented no previous history of ulcer whatsoever, their first symptoms being sudden agonizing upper abdominal pain. Of those having had symptoms of chronic ulcer, only one reported hæmatemesis and melaena. The majority had had post-prandial pain, acid eructation, pyrosis, vomiting, belching, and pain relieved either by emptying the stomach or by the ingestion of more food.

In regard to predisposing causes, practically all of the series had focal infections of various grades of severity. Several had had appendicitis and one had had his appendix removed with the hope of relieving indigestion. Tonsillitis, quinsy, influenza, and pneumonia were given among the previous diseases. The Wassermann reaction was positive in but one case. Nothing definite could be deduced in regard to alcohol, tobacco and other remote predisposing factors. One patient, however, said he had been drinking almost constantly for two weeks and when admitted, following perforation, was afraid he would be considered as merely inebriated. Direct trauma was the suspected activating cause of the rupture in the last case.

In all but one the attack was initiated by sudden exceedingly severe upper abdominal pain. This exceptional case had premonitory vomiting of blood fifteen minutes before the pain appeared, although it is to be noted that no demonstrable blood was found in the abdomen at operation. Pain remained a constant symptom in all but one, the so-called intermittent period or lull with complete cessation of pain being absent in all others.

The symptoms of nausea after the onset of the acute condition was present in one-half of the series, and was more frequent in the cases showing the soft, small type of recent ulceration. One-half had vomiting of recently ingested food between the onset of the acute trouble and the operation. Two had regurgitation of nearly clear fluid and had recurring attacks of severe retching. Three had no vomiting or retching. Intense thirst and request for water was common to all.

At examination, all tended to guard and steady the abdomen by flexed knees or folded forearms and a position once assumed was rarely changed. While all were prostrated, two patients were noteworthy for recurrent attacks at fairly long intervals marked by restlessness and constant change of posture. In both of them intense pain was the first symptom, but uncommonly enough this pain tended to be intermittent in character. They were both observed very shortly after the onset of the acute attack and were the only cases to show even a slight degree of shock. At operation both presented small perforations in soft ulcers of the recent variety. While all of them were "knocked out," nothing uniform was determined about the appearance of the face, the presence of sweat or the expression about the eyes. None requested alcohol, a diagnostic point occasionally emphasized. The great majority resented examination, objected to the effort of moving about and of articulation, and begged for relief from their distress.

While some abdominal distention was present in four instances, the only one to show marked general distention was a case where four days had elapsed after the onset of the acute condition. All but one presented definite auscultatory peristalsis, and in all, general tenderness was present and more marked in the epigastric region, but in only one was it definitely localized over the duodenal area. Board-like rigidity was present in all except a four-day case, but inconstant in two others; each of the latter had a small perforation of a minute non-calloused ulcer, and rigidity was unexplainably intermittent. The only one to present generalized advanced peripheral peritonitis was a fatal four-day case. This, too, was one of two patients in the series to exhibit pelvic tenderness. Tympany in some degree was present in all and obliteration of the liver dulness, while not pathognomonic of perforation of the duodenum or, indeed, of any hollow viscus, was observed in seven cases. Emphysema of the abdominal wall was not encountered.

The pre-operative temperature was notable because of a uniform sub-normal finding, the average being 97.7 degrees. The average pulse on examination was 88. There was a slight increased respiratory rate, but this was not marked. Two cases exhibited definite diaphragmatic irritability as evidenced by short, catchy respirations. The white count was generally increased, the longer the time elapsing between onset and examination the higher being the total count.

In all but one of the series our pre-operative diagnosis proved, on laparotomy, to be correct. The one mistake was made in the four-day case, the one

female in the series, in which the history, from the onset, pointed somewhat to the pelvis. Gastric ulcer perforation and appendicitis were the reserve diagnosis in two cases. The average time between perforation and operation was fifteen and a half hours. Omitting the four-day case, the interval was six and a half hours for the remaining nine. In discussing the signs, symptoms and results in this report, our good fortune in securing these cases early must be commented upon.

The gross pathological diagnosis of the ulcer exposed on laparotomy was four of the small, soft, recent type and six of the hard, chronic, calloused variety. None of the former had a previous history of ulcer, while all of the latter did; thus, the pathology and the history coincided. In no case was multiple perforation found; no contact or multiple ulcers were observed. In every case the position of the ulcer was within one inch of the pyloric vein. Four were situated directly on the anterior aspect of the first part of the duodenum, four were on the superior margin, and two were on the intermediate antero-superior position. None were present in the inferior or posterior surfaces. The diameter of the ruptured area varied between 2 mm. and 1 cm., the majority being of the smaller size. All of the perforations, including the one possibly burst through by direct trauma, were rounded, punched out and had smooth edges. Adhesions about the ulcerated area were not present in any instance. In none was there active bleeding from the ulcer. Gas was escaping and duodenal fluid was leaking from all; in all cases the abdominal cavity contained varying amounts of clear, turbid or mucoid fluid, while in none were demonstrable food particles. Even in the two cases who were restless, as in acute appendicitis or as in inflammatory or calculus involvement of either the biliary or the upper urinary tracts, no evident difference in the character of the extruded material could be noted. One each presented definite injection of the peritoneum and diffuse purulent peritonitis and needless to remark, both of them came to operation late. But a single case was noticeable for obstructed pylorus. No coloring matter, such as methylene blue, was given by mouth to aid in locating the perforation. This would seem quite unnecessary. A tentative diagnosis of rupture contraindicated pre-operative stomach lavage.

The various operative procedures employed were: simple closure of the perforation and reinforcement with additional sutures (2 cases), excision of ulcer with modified pyloroplasty (1 case), enterorrhaphy with gastro-jejunostomy (5 cases), excision and closure of ulcer and gastro-jejunostomy (2 cases). In all but two cases, advantage was taken of neighboring gastro-hepatic omental tabs to reinforce the sutured area. Of the two fatal cases, one had simple closure of the perforation while the other had both infolding plus posterior gastro-jejunostomy. Three operations were completed by removal of the appendix. In none were adhesions of any great importance or involved gall-bladders found. All were drained by a single drain through a suprapubic stab wound; one had an additional drain into the region of the right kidney

pouch, while none had drainage to the various suture anastomoses or through the laparotomy incision.

The post-operative care of all was the accepted expectant treatment for peritonitis; elevation of the head of the bed, administration of an adequate amount of morphine, application of external heat, and large quantities of fluid by rectal, intravenous, and subcutaneous routes. As soon as water was tolerated by mouth it was forced. Fluid diet was started the second or third day, after which soft diet of the bland variety was increased and continued. All drains were removed within a seventy-two hour period.

Of the total number of ten cases observed, eight (80 per cent.) were discharged from the hospital recovered, and two (20 per cent.) died. Perforation of an old chronic ulcer occurred in both fatal cases. The one female patient in the list came to operation four days after the acute perforation, and expired on the table. She had an ulcer history of eight years' duration and, at laparotomy, presented extensive peritonitis with multiple scattered abscesses. No definite attempt to close the perforation by nature was found. Contemplating the findings, this case would fall among the complications of acute perforation. The other fatal case came to operation nine hours after perforation and had a history of ulcer trouble for seven years previously. Curiously enough, this was the only patient in the series who had received any proper anti-ulcer treatment, and this was in active process at the time of perforation. The average duration of stay in the hospital of the remainder was twenty-two days. (Table I.)

These findings are presented for the purpose of adding to the reported number of these relatively infrequent cases. We believe that the diagnosis is essentially clinical, the observed findings being of far greater value in the time permitted than all laboratory examinations. The determination of acute perforation is usually a simple matter, as certain symptoms are sufficiently distinctive and sequential to make it positive. To be confronted with an individual, and usually a male, making every mental and physical effort to obtain relief from a sudden, intensely severe, fairly constant, almost unbearable abdominal pain, and showing rigidity, only to be expressed as board-like, is highly indicative of perforation of an hollow viscus. But adding to this, a history of previous gastric disturbance, plus certain fairly constant clinical findings, a definite diagnosis can be arrived at. However, it must be noted in the occasional case the picture while being that of an acute abdominal crisis, is not clear enough to establish a definite clinical opinion. Seen shortly after acute perforation, the appearance of the patient may be deceiving. On inspection, shock and collapse seem apparent, but true surgical shock according to the accepted definition, which includes a rapid thready pulse and an evident fall in blood pressure is surprisingly absent. Instead, however, the majority of cases show a pulse of strong, full type and slow rate, as well as no distinguishing change in the blood pressure. Furthermore, at the onset the peritoneum appears to be fairly resistant to the outpouring of gastric contents

TABLE I.

Hospital number	Sex	Age	Past history ulcer	Pre-operative interval after rupture	Pain	Rigidity	Shock	Obilitation liver dullness	Gross pathology of ulcer	Operation	Result	Remarks.
10340-A	Male	36	2 years	5 hours	Constant	Constant	None	Yes	Hard	Duodenorrhaphy and gastro-jejunostomy	Recovered	
11318-A	Male	33	4 years	4 hours	Constant	Constant	None	Not stated	Hard	Duodenorrhaphy and gastro-jejunostomy	Recovered	
675-B	Male	46	7 years	9 hours	Constant	Constant	None	Yes	Hard	Duodenorrhaphy and gastro-jejunostomy	Died	Syphilis and myocarditis.
974-B	Male	27	5 days	5 hours	Constant	Constant	None	Yes	Soft	Excision ulcer and pyloroplasty	Recovered	
2205-B	Male	43	7 years	5 hours	Constant	Constant	None	Yes	Hard	Duodenorrhaphy and gastro-jejunostomy	Recovered	
720-B	Female	50	8 years	4 days	Constant general pelvic	Constant	None	Yes	Hard	Duodenorrhaphy	Died	On table. Purulent peritonitis.
9540-A	Male	40	None	5 hours	Intermittent	Intermittent	Mild	Yes	Soft	Excision ulcer and gastro-jejunostomy	Recovered	
7923-B	Male	19	7 days	5 hours	Intermittent	Intermittent	Mild	Yes	Soft	Duodenorrhaphy and gastro-jejunostomy	Recovered	
10481-B	Male	35	15 years	1½ hours	Constant	Constant	None	Yes	Hard	Excision ulcer and gastro-jejunostomy	Recovered	
10485-B	Male	56	None	14 hours	Constant	Constant	None	Yes	Soft	Duodenorrhaphy	Recovered	Exciting cause. Traumatic.

for some hours. Profound shock and rising peritonitis will soon follow when an immense amount of exceedingly toxic gastric material has escaped through a large perforation. Therefore, the early appearance must be disregarded and immediate surgical intervention be instituted in order that the advancement of insurmountable difficulties be prevented.

The walls of the duodenum may perforate acutely by an ulcerating defect in the base of an old-established ulcer or by a rapid, acute ulcerative process. Following the occurrence of rupture it may be almost impossible to differentiate clinically between the two types, except by the history. An history of long disturbed gastric function prior to perforation is indicative of ulceration through the thinned out base of a chronic, calloused, established ulcer, while the small, soft, recent, necrotic, or embolic ulcer may first make its presence known by sudden rupture. Some differences may appear in the cardinal symptoms immediately subsequent to perforation which may further serve to distinguish between the two types. Two of our cases are noteworthy because pain, rigidity and restlessness were intermittent instead of being constant in character. Small soft-walled perforations were present in both.

Considerable discussion has arisen of late in regard to the extent of the surgery necessary for the relief of these cases, and numerous are the procedures advised by various advocates. We believe that the character and location of the perforated lesion and the general condition of the patient are the important factors in determining the proper surgical therapy. That immediate closure of the perforation is essential, whether the lesion has occurred primarily or as a complication of an old ulcer, is self evident. The general condition of the patient and the local findings will determine the advisability of any additional procedures. Insecure suturing of the defect will call for omental support, while insufficient closure or a lumen too greatly narrowed by operative technic or by extensive involvement of the previous ulcerative process may demand relief by gastro-enterostomy. Inclusive excision of the induration surrounding the perforation, followed by a modified pyloroplasty, has the distinct advantage of removing the entire diseased area. Likewise the same result may be claimed for primary sleeve resection of the ulcer-bearing area, but rarely will the condition of the patient following perforation permit of such radical treatment. Frequently, progress is more sure when the operative therapy is applied in the successive steps of the multiple stage operation.

CONCLUSIONS

Perforation of the duodenum, whether simple or as sequence to chronic ulcer, is a condition uniformly susceptible to cure by immediately instituted surgical means.

Two types of duodenal ulcer may perforate; the large, calloused, chronic variety, and the small, soft, recent type. A positive history of previous ulcer will aid in diagnosing the former, while the findings of acute rupture are usually, not always, the inaugurating symptoms in the latter.

The early symptoms of rupture are fairly uniform and are the typical findings in upper intra-abdominal hollow viscus perforation. However, pain, rigidity, and restlessness may occasionally be intermittent rather than constant; soft ulcers exhibiting more frequently the intermittent factor than do hard ulcers. History alone may indicate the perforating organ or may be of doubtful value. A differential diagnosis is not of practical value, for the treatment is the same.

Immediate closure of the perforation is the prime essential in the surgical treatment. The desirability of additional procedures depends on the local findings and on the general condition of the patient at the time. Excision of the ulcer, modified pyloroplasty, gastro-enterostomy and their combination, each has its indication. More extensive surgery is rarely advisable. Our results having been equally satisfactory with the various methods used, we state no preference, preferring to individualize.

Careful attention to diet is of great importance early as well as long after the operation.

Preëminently, the immediate results depend less on the type of surgical therapy employed than on the time interval allowed to elapse between the perforation of the ulcer and its proper surgical treatment.

ACUTE INTUSSUSCEPTION IN INFANTS*

BY RICHARD W. BOLLING, M.D.

OF NEW YORK, N. Y.

In this article I shall limit myself to a consideration of my experience in acute intussusception in infants twelve months of age or less. My series comprises fifty-one operations on fifty patients, with an operative mortality of 15 or 30 per cent. My experience in older children is limited to two patients with one death. In both instances the intussusception occurred during a severe attack of ileo-colitis. These patients were all operated on by me at the Babies' Hospital, on the service of Dr. Wm. A. Downes, to whom I am indebted for the privilege of operating.

Much attention has been directed in the past fifteen years to the symptoms and treatment of acute intussusception in infants. Many excellent articles have appeared in the literature establishing the fact that the proper treatment of the condition is operative, that the operative mortality is directly proportional to the duration of the symptoms and that, in the great majority of cases, if reasonable care is observed, the diagnosis may be made within twelve to twenty-four hours. Apparently it is necessary to go to Australia to find a community where the early diagnosis of acute intussusception is the rule. C. P. B. Clubbe,¹ of Sydney, Australia, in an excellent monograph based on his experience since 1893, reports 270 cases of acute intussusception, with a mortality of 20 per cent. Of these cases 88.5 per cent. were twelve months old or less. There is included in this report a consecutive series of 100 operations with a mortality of 7 per cent. P. L. Hipsley,² of the same city, reports fifty-one operations with a mortality of four, or 8 per cent. When I compare these figures with my own and with the statistics of other operators, here and abroad, I cannot but be impressed by the fact that our present mortality in this condition is too high. Strictly speaking, the mortality, while classed as operative, is not the mortality of the surgeon operating, but of the medical community which he serves. In no other condition, with which I am familiar, is the result of operation so directly dependent upon the prompt diagnosis of the family physician.

Acute intussusception is the most frequent abdominal emergency in infants. Approximately 75 per cent. of all acute intussusceptions occur in infants twelve months old or less and at least 50 per cent. in the period from five to nine months. Males always predominate, the ratio being about two to one. Among my patients there were thirty-one males and nineteen females. The youngest patient was five weeks old, the oldest twelve months. Twenty-seven were in the period between five and nine months.

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The nomenclature has suffered from an unnecessary exuberance of terms, and it is rare indeed to find two authors in entire agreement as to terminology. There is no reason for designating every possible variety of intussusception by some separate name. The list would be endless and would serve no useful purpose. The classification used by Clubbe³ seems entirely practical, and I have adopted it in my series. He recognizes four types: ileocæcal, entero-colic, enteric and colic. In the ileocæcal type are included both the form in which the head of the cæcum is the last part of the intussusception to unfold and that in which the ileocæcal valve forms the apex, the former being but a variant of the latter.⁴ Included in the entero-colic type are two forms. In one, an intussusception, beginning in the ileum, near the valve, goes through the valve and increases at the expense of the cæcum and colon. In the other, the intussusception begins in the ileum, but when it reaches the valve it does not pass through, but pushes the valve before it, and increases at the expense of the cæcum and colon. In the former, when the cæcum has been completely unfolded, there remains a mass within the cæcum. In the latter, when the cæcum is being unfolded, an enteric intussusception is seen to emerge, and when the cæcum is quite unfolded it is found to be empty. Entero-colic intussusceptions, therefore, are really double, the "compound intussusception" of some authors, and in my opinion, are much more frequent in occurrence than is generally supposed, a fact which was emphasized by Cuthbert Wallace.⁵

The terms enteric and colic are self-explanatory. In the former group is included the form sometimes termed the ileo-colic, in which a small amount of the ileum is found in the cæcum, without any infolding of the cæcum or involvement of the appendix. To this simple classification into four types, there must be added the very rare forms taking origin in inversion of the appendix or a Meckel's diverticulum; the jejuno-gastric, a form which will rarely if ever be encountered in infancy, and the retrograde. Retrograde intussusceptions are those in which the lower portion of the intestine is invaginated into that above it. This form is quite commonly met with in the post-mortem room, the so-called agonal intussusception, but it is rarely seen during life.

All authors agree that the region of the ileocæcal valve is involved most frequently in this condition. In my series there were twenty-six ileocæcal, nineteen entero-colic, five enteric (including three so-called ileo-colic forms). In one enteric intussusception an inverted Meckel's diverticulum formed the origin. In one of the ileocæcal type, a small mucous cyst formed the apex. There was only one colic form encountered and this involved the ascending colon, just distal to a small ileocæcal intussusception, in the only instance of multiple intussusception which I have met with. In one case the type was not noted.

There is probably no single definite cause producing invagination of the intestine. Many theories have been advanced, none of which completely satisfies all conditions. It is reasonable to assume that the great mobility

of the lower ileum, cæcum and ascending colon in early life is a predisposing cause. It is also generally acknowledged that the bowel is more irritable and that its muscular action is less well coördinated than in later life, both of which factors may tend to produce invaginations. Undoubtedly perverted peristalsis is one of the ways in which an intussusception may arise. While abnormal conditions of the gut-wall and new-growths do excite the formation of intussusceptions, such forms are very rare in infancy. In an excellent article Perrin and Lindsay⁶ formulate a theory to account for the majority of intussusceptions which they briefly recapitulate as follows:

1. "The determining factor is the production of the equivalent of a foreign body within the intestines. The foreign body is provided by the swelling of the preëxisting lymphoid tissue. The anatomical and age distribution of the lymphoid tissue in the alimentary canal agrees exactly with the anatomical and age distribution of intussusceptions."

2. "The factor that provokes this swelling is some gastro-intestinal disturbance. The secondary maximal incidence which occurs between five and nine months is accounted for by this."

Injudicious feeding as a cause has been stressed by many authors. In most of my cases I was unable to elicit any history pointing to this, though I am confident that it existed fairly frequently. Among my patients forty-one were wholly breast-fed and nine were wholly or partly nourished on modified cow's milk. In only seven was there any history of previous intestinal disturbance. However, twenty-four, or almost 50 per cent., of my cases occurred during July, August and September.

The pathological changes in an intussusception are the result of compression of the vessels of the mesentery. The veins and lymphatics are blocked and become so distended that the walls give way and blood and lymph are poured into the wall of the intestine and onto its surface. The involved intestine becomes œdematous and infiltrated and it is this that makes reduction difficult and sometimes impossible. In very acute cases where the arterial supply is cut off, gangrene soon follows. In most articles, reference is made to adhesions and difficulty in reduction is ascribed to their presence. I have never noted the presence of adhesions in any of my cases. The surface of the bowel is often very ecchymotic and may be rough and granular. Even after resection of the invaginated gut, reduction may be impossible, but in my experience, this has always been due to the œdema and infiltration. While in a general way the extent of the pathological changes is determined by the duration of the condition, yet there may be great individual variation. For instance, in two of my cases giving identical pathological findings, one gave a clear history of twenty-four hours' duration and the other of six days. The former died, while the latter recovered, after a stormy convalescence. Obstruction is not always complete and the passage of flatus and fæces does not always militate against the diagnosis of intussusception. In the beginning the severity of the symptoms depends upon the degree of interference with the circulation, rather than upon obstruction of the bowel. Later the symp-

toms of obstruction appear with distention, toxæmia and fecal vomiting. In symptomatology, it seems to me desirable to divide intussusception into two classes. The first comprises the great majority of the cases, and it is in this group particularly, that we may hope to reduce the mortality by early diagnosis. In most cases in this group the diagnosis should be made from the history. There is no clinical picture more definite than the typical intussusception and I wish to emphasize the fact that the typical intussusception is the usual intussusception. A previously healthy, well-nourished, breast-fed baby screams while nursing or passing a stool, turns pale, vomits, recovers in a short time only to cry again and draw up his legs as if in pain. Shortly after the attack one or more normal stools may be passed and within a few hours blood, blood and mucus, or both mixed with fæces, will be passed per rectum. At this stage, save during the paroxysm of pain, the child may not look ill and there is usually no rise in pulse or temperature. This is a very important point, for many times it is hard to persuade the onlooker, that a child can have such a serious condition and yet appear so well. The infant usually refuses to nurse, but that is not necessarily so. There are, of course, some cases not so typical. The child may only appear fretful, may not even vomit and the mother's attention is first drawn to the condition by the bloody stool. Very occasionally there is no history suggesting an intussusception, as in the following case. A bottle-fed, seven months' old, female infant, had a nasal discharge and cough for four days. Two days ago was constipated and was given castor oil, with good result. This morning the baby started to cough and almost choked. A doctor was summoned and sent the baby into the hospital with a diagnosis of pneumonia. On routine examination by the resident, a rounded mass was made out in the epigastrium and a few minutes later the baby passed a stool containing blood. I was called and operated, easily reducing an entero-colic intussusception.

The other group is much smaller, comprising seven of my series, and consists of those intussusceptions occurring during an attack of ileo-colitis. While this is an unusual occurrence, it is sufficiently frequent to make it very desirable to keep the possibility in mind. The onset during ileo-colitis may be very acute, with all the classical symptoms. More often it is insidious and even after diagnosis is made, the duration of the invagination is often in doubt. In this class of patients the tumor is the most valuable, and may be the only diagnostic sign. The diagnosis is often exceedingly difficult and I am under the impression that intussusception as a complication of ileo-colitis is rather more frequent than is generally believed. It is fortunate that this group of cases is relatively small, for not only will the diagnosis be made late in a certain number of cases, but even if the condition is recognized early, the intussusception is merely an incident in a disease which has a high mortality of its own.

A physical examination should of course be carefully carried out in every instance, though in the majority of cases it is of secondary importance to the history. Usually an abdominal tumor may be made out, and certainly its

absence cannot be asserted unless an examination under anæsthesia has been made. In forty-six of my patients I was able to demonstrate a tumor. In four the distention was so great that it was impossible to define a mass. In one there was a small mass under the liver which I could not make out. An abdominal tumor is by no means essential to the diagnosis. The mass has been described as "sausage-shaped." Sometimes it is, but frequently it is rounded. It may be made out in any part of the abdomen, though usually, in early cases, it is found on the right side or in the epigastrium. In late cases, it is usually found on the left side. In three of my patients there was incomplete rotation of the colon, a fact which naturally influenced the position of the tumor. In fifteen patients I made out a tumor by rectal examination. This examination should always be made, but more often than not affords little information. Blood, blood and mucus, and rarely blood mixed with fæces, was noted in all but one of this series.

Ulcerative colitis and Henoch's purpura may be confused with intussusception. In the former the stools contain fecal matter, whereas in intussusception they are usually composed of blood and mucus. In certain instances in colitis, the mesocolon is thickened and may suggest a tumor, but as Clubbe⁷ points out, this mass is longer and less definite and can never be felt in the rectum. Henoch's purpura rarely occurs in children under three years. The symptoms are purpuric spots, swelling of the joints, abdominal pains, intestinal hemorrhage and vomiting. Unfortunately the abdominal symptoms may precede those of the purpura. Hugh Lett⁸ records a case of Henoch's purpura complicated by the presence of two separate intussusceptions occurring at intervals of seven days. The patient was three years old. Another author refers to a case of Henoch's purpura in which the diagnosis of complicating intussusception was apparently confirmed by the presence of an abdominal mass. At operation, the mass was found to be a hemorrhage in the wall of the intestine. In spite of this finding the presence of a mass in the abdomen in a patient suffering from purpura and with symptoms suggesting intestinal obstruction, is sufficient indication for a laparotomy. I have recently operated upon an infant of eight months in whom the diagnosis was in doubt. There was a mass across the epigastrium which was not unlike that of an intussusception. The history, however, was not suggestive of this condition. The operation revealed an acute pancreatitis. As a matter of fact the diagnosis is usually clear, and it is in those patients in whom an intussusception is intermittent in an attack of ileo-colitis that the greatest difficulty will arise. I have never had occasion to use the Röntgen-ray, but in a doubtful case the possibility of its use should be borne in mind.

In my opinion the treatment should be laparotomy, carried out at the earliest possible moment. There is no indication for the employment of aero-hydrostatic methods, save in cases where the services of a surgeon are not available.

In my series the duration of the symptoms varied from six hours to six days. The average duration in those that lived was twenty-eight hours; in

those that died sixty hours. No patient was lost in whom symptoms had existed for less than twenty-four hours.

There were fifteen deaths. Five followed resection. In all of these the involved gut was gangrenous and in three reduction was impossible. One followed excision of a small inverted Meckel's diverticulum. In one infant in extremis and greatly distended, a palliative ileostomy under local anesthesia was the only operation. There was one death on the tenth day from a perforating ulcer of the ascending colon, at the site of an injury sustained during a difficult reduction. In retrospect, the tear in the peritoneum should have been sutured with fine silk and a free graft of omentum applied. One patient died on the table, during operation under local anesthesia. Five infants died within a few hours after operation, apparently from shock and toxæmia. One, removed against advice, died the next day.

As to Technic.—If there has been vomiting, and in any case with distention, the stomach is washed out preliminary to anaesthesia. The operative field is prepared with one-half strength tincture of iodine. Great care is observed to prevent the loss of body heat. Ether anaesthesia by the open drop method is preferred. Very rarely there is indication for local anaesthesia. The incision is a generous one, through the inner third of the right rectus, with the mid-point slightly below the umbilicus. Where there is a tendency to prolapse of distended intestine, I have found it wiser to disregard it and to complete the operation as rapidly as possible. An attempt is made to reduce the intussusception intra-abdominally until the ascending colon is reached, when the mass is delivered and reduction completed under the eye of the operator. In certain instances where the reduction is difficult, it may be desirable to deliver the mass even while it is in the descending colon. It will be necessary to replace it, however, when the splenic and hepatic flexures are reached. The reduction should be carried out by squeezing from below upward and expressing the intussusceptum from its sheath. This manœuvre should, if possible, be accomplished by the gloved fingers alone, without the aid of gauze, to avoid injurious pressure. When the reduction is difficult, I have been aided by grasping the mass and attempting to reduce the œdema by gentle pressure. Occasionally it is permissible to pull gently upon the entering loop, rather to direct the expulsion of the mass in the proper axis than to exert traction. As suggested by Dow,⁹ I have at times introduced a sponge forceps between the entering and returning layers at the neck and gently separated the blades. In one form of the entero-colic type, it is important to remember the course of the invagination. In this form, the intussusception has gone through the valve, and after the cæcum is unfolded a mass can still be felt in the cæcum. To effect the reduction of this mass, it is desirable to exert pressure so that the intussusceptum will be directed out through the valve in the axis of the ileum. If pressure is exerted in the axis of the ascending colon and cæcum, the reduction may not be effected. It is important to "iron out" the little dimple which usually forms the apex of the intussusception. No attempt should be made to anchor the cæcum.

In three cases, however, where there was little reaction in the intestine after the easy reduction of ileocaecal intussusceptions, I have paralleled the ileum and ascending colon just above the valve, by means of three or four interrupted silk sutures, as suggested by Cubbins.¹⁰ I have so far had no occasion to remove the appendix. If an inverted or gangrenous appendix be encountered, an appendectomy should be carried out, but not otherwise. One of the reasons advanced for a routine appendectomy is the prevention of recurrence. There are at least two cases^{11, 12} on record where recurrence occurred, in which appendectomy had been done at the original operation.

Resection is avoided wherever possible, and I have been repeatedly impressed by the recuperative power of apparently badly damaged gut. In performing resection, axial anastomosis is preferred. In one patient a two-stage resection was attempted, but the child died shortly after the preliminary operation. Clubbe¹³ reports a successful result with a two-stage operation in a six months' old infant. This method should receive consideration in desperate cases. Since Peterson¹⁴ reported the first successful resection for gangrenous intussusception in an infant, quite a number of such cases have appeared in the literature. The most notable is that of Dowd,¹⁵ who successfully resected an irreducible intussusception in a five days' old infant.

In one instance I did an ileostomy four days after reduction, where vomiting and distention persisted, apparently due to paralytic ileus. In this patient the duration of the symptoms prior to operation was six days. The result was successful. It is my intention, in the future, to use ileostomy more frequently in patients where the distention is marked.

Among my patients there was one recurrence in a child of eleven months, five months after operation for the original intussusception. Both were of the ileocaecal type. There are many instances of recurrence noted in the literature, but relative to the total number of cases of intussusception, it must be quite rare.

Spontaneous reduction does occur. I have operated on one patient in whom the lower ileum and caecum bore obvious evidence of a reduced invagination. The possibility of spontaneous reduction should, of course, have no bearing on the treatment of the condition.

The closure of the wound is a very important part of the operation and should be carried out in layers, with painstaking care. Drainage is not desirable. Two instances of post-operative separation of the wound were encountered in this series. Both patients recovered.

The dressing is small and retained by long straps of adhesive. The post-operative treatment depends on the pathological changes in the gut. In the early cases it is very simple. For the first twelve hours we allow only water, then diluted breast-milk, in increasing amounts for thirty-six hours. On the third day breast-milk or the formula is allowed and by the fourth or fifth day the infant is back on his regular diet. We do not hesitate to give a hypodermoclysis of 3 per cent. glucose solution in amounts of 100 to 250 c.c.,

depending on the size of the child. This I believe to be a most valuable measure and may be carried out twice a day in dehydrated infants. If vomiting persists, the stomach is washed out. Pituitrin and enemata are given for distention. In any case a colon irrigation is given on the first post-operative day. When there has been much damage to the wall of the gut, there is a tendency to colitis and the post-operative feeding is very carefully watched. There is frequently a sharp post-operative rise of temperature, which usually subsides in thirty-six hours. The stay in the hospital is ten days in uncomplicated cases.

In spite of the high mortality for the series, I am somewhat encouraged by the fact that in the last seventeen consecutive cases there has only been one death, which followed resection in an eight months' old infant. This child lived eight days, dying of broncho-pneumonia.

Of the thirty-five patients surviving, I have been able to follow twenty-seven: two for five years; seven for two to three years; six for one to two years; twelve for less than one year. There were two deaths: one as a result of ileo-colitis two months post-operative; the other two years after operation of scarlet fever. There were two ventral hernias; one following a wound infection, occurring in a patient in whom there had been excision of an enteric cyst. This child has been followed for two years, and it is interesting to note that as the child has developed, the hernia has decreased in size, until now it can scarcely be demonstrated. This spontaneous cure of ventral hernia in growing children is a fact worthy of attention. The other hernia followed primary wound healing. This child was lost sight of after a few months. With the exception of these two complications and the two deaths, all the other children developed normally.

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EXPERIMENTAL STUDY UPON THE USE OF INTRA-ABDOMINAL INJECTIONS OF HYPERTONIC GLUCOSE SOLUTION IN THE TREATMENT OF PERITONITIS

BY JOSEPH K. NARAT, M.D.

OF CHICAGO, ILL.

DEPARTMENT OF PATHOLOGY, LOYOLA UNIVERSITY SCHOOL OF MEDICINE

THERE are two chief essentials in the treatment of acute free peritonitis: 1. To remove the source of infection, *i.e.*, the primary focus. 2. To combat the general infection and intoxication.

The first question belongs to the field of surgical technic and shall not be discussed here. Concerning the second question, it should be the aim of the therapy to aid the organism in its physiological methods of defense. How does the organism go about the reaction against an invasion of peritoneal cavity by bacteria? The organism protects itself from the spread of the germs in this way, after a short period of resorption the peritoneum produces exudate into the abdominal cavity. The organism sends liquid and solid elements to the battlefield; the exudate serves to dilute the toxins; by means of the transudation the leukocytes come into the peritoneal cavity where they bring about the action of phagocytosis. Murphy, Bordet and others¹ expressed the opinion that the danger of peritonitis is proportional to the absorption. Lennander² says: "The more abundant the secretion the better the prognosis." Thus the limitation of absorption and promotion of exudation are the methods of defense which the organism uses against the danger of general infection. We can assist these efforts of the organism by trying to repress the resorption and to increase the exudation.

Much experimental work has been done on this subject. The more important contributions in this field may be shortly reviewed.

In order to prevent absorption, Clairmont and Haberer³ painted the diaphragm in animals with collodium. Other men with the same purpose used zinc paste. Glimm⁴ experimented with pouring olive oil into the abdominal cavity. Pfannenstiel and Hoehne,⁵ Hirschel,⁶ Krecke⁷ and others report favorable results obtained by using camphor oil instead of olive oil. The camphor oil tends to limit only the absorption of bacteria which enter the lymph vessels, but not of the toxins which are resorbed by the blood-vessels. Another objection to the use of oil is the fact that several cases of oil emboli following this treatment were reported.

In the experiments of Schnitzler and Ewald,⁸ glycerin proved to be a remedy which limits the absorption but is extremely dangerous. Exner⁹ succeeded in retarding the absorption of toxins from the abdominal cavity by pouring adrenalin into it.

All of these methods proved unsatisfactory.

We experimented, therefore, with so-called osmotherapy which has been applied with great success in a wide variety of clinical conditions during the last fifteen years. We are indebted to van der Velden¹⁰ for the introduction of this method. In 1909, he administered hypertonic salt solution intravenously to patients in cases of hemorrhages. Weed and McKibben¹¹ demonstrated that after injection of hypertonic salt solution the brain diminishes in size and cerebrospinal pressure decreases. Cushing and Foley,¹² Sachs and Belcher¹³ applied this method to patients with cerebral herniæ and brain tumors with satisfactory results. Sansum¹⁴ succeeded in reducing the intraocular tension in glaucoma by means of intravenous injections of hypertonic salt solution. Wells and Blankinship¹⁵ report remarkable results in the treatment of influenzal pneumonia with the same method. Lichtfield¹⁶ uses it in typhoid fever, meningitis and other serious infectious diseases, Erlanger,¹⁷ to combat the traumatic shock. Von Noorden and Salomon,¹⁸ Singer,¹⁹ Gärtner and Beck²⁰ recommend it to check profuse diarrhœa in dysentery and cholera. Stejskal,²¹ Lo Monaco,²² Medevielle²³ furnished the proof that intravenous injections of hypertonic solutions produce general inhibition of glandular secretion. Singer²⁴ reports that he succeeded in diminishing the night sweats of tuberculous patients, controlling hyperacidity of the stomach, profuse expectoration in asthma, tuberculosis and œdema of the lungs. Stejskal successfully limited the internal secretion of the thyroid gland; the goitres decreased in size and the thyrotoxic symptoms were not so pronounced. Wright²⁵ recommended "lymphlavage" of the wounds by means of dressings saturated with concentrated salt solution. Moynihan,²⁵ Rogge,²⁶ Stiede²⁷ used the same method and noticed an increase in secretion and a more rapid healing of the wounds. Strauss²⁸ combats uræmia by means of intravenous injections of 20 per cent. glucose solutions. Max Buerger and Hageman²⁹ spoke of a mobilization of œdema by means of osmotherapy. No harmful effects following the administration of hypertonic salt or sugar solutions were observed in any of the above-mentioned experiments.

The success of this method in the treatment of various pathological conditions, suggested the use of the physical act of osmosis in the treatment of acute free peritonitis.

The fundamental facts concerning the osmotic processes in the abdomen are summarized in Hamburger's book "Osmotic Pressure and Ions."³⁰ He demonstrated that the osmosis takes place also through a serous membrane which has been badly injured, for instance, by hydrochloric acid, heat and so on, or even in dead animals; the transudation is chiefly a physical process.

We are indebted to Wegner³¹ for the exhaustive study of the capability of the peritoneum to secrete. He calculated that the peritoneum in a woman of medium size has an area of 17,182 square cm., almost equal to the total surface of the body of the same person, which was 17,502 square cm. Wegner injected into the abdomen liquids of a high diosmotic equivalent such as

concentrated sugar solution and found that in one hour an amount of liquid equal to 4 to 8 per cent. of the weight of the animal was secreted.

Kuhn³² repeated the same experiments and recommended the use of hypertonic sugar solutions in peritonitis. Rogge,²⁶ following the suggestion of Rindfleisch, used hypertonic salt solution in several cases of peritonitis.

After this short review of literature, we may proceed to an account of our own experiments and their results. We studied systematically the efficiency of intra-abdominal injections of hypertonic sugar solution in peritonitis. For this purpose we used ninety rabbits, approximately of the same size and weight.

We found that a normal rabbit can stand safely an injection of one-fiftieth of its weight in 20 per cent. glucose. After injection of a larger amount of glucose, some of the animals died with cramps because of a rapid dehydration of the blood.

In order to determine the rate of secretion we injected the same amount of glucose into a group of animals and killed them at certain intervals to test accurately the quantity of liquid secreted. The experiments showed these results:

Following injection of 50 c.c. of a 20 per cent. glucose we found in the peritoneal cavity:

After 1 hour, 85 c.c. colorless, clear, partially coagulated liquid; after 2 hours, 70 c.c.; after 2 hours 20 minutes, 90 c.c.; after 2 hours 30 minutes, 140 c.c.; after 3 hours, 110 c.c.; after 3 hours 20 minutes, 140 c.c.; after 3 hours 30 minutes, 97 c.c.; after 4 hours 30 minutes, 120 c.c.; after 5 hours 30 minutes, 90 c.c.; after 7 hours, 100 c.c.; after 7 hours 30 minutes, 150 c.c.; after 24 hours, 0.

By injecting physiologic salt solution hypodermically we were able to increase still further this enormous transudation. For example, in one rabbit we obtained 150 c.c. of liquid two hours after glucose injection, and in another one as much as 200 c.c. seven hours later; this shows an increase of four times the amount injected.

In the second group of animals we produced peritonitis by injecting a culture of staphylococci the virulence of which was intensified to such a degree as to cause death in approximately forty-eight hours. An incision was made in the midline without anæsthesia, the peritoneum exposed, a canula introduced and a purse-string suture placed around it; 5 c.c. of suspension of bacteria simultaneously with a small blood-clot were injected, the canula withdrawn, the suture tied, and the abdominal wall closed by means of continuous sutures. The glucose was injected four to twenty-four hours after introduction of staphylococci. The injections were repeated three to six times, at intervals of six to twelve hours. The results were as follows: All the twenty control animals which received injections of staphylococci only, died within twenty-four to forty-eight hours. Of the animals which after production of peritonitis received glucose injections, only one died after thirty-

six hours. Three died after six, nine or eleven days, respectively. The remaining fourteen survived the experiment, but with exception of one were killed to determine the pathologic changes about three weeks later. In all these animals we found a pronounced free peritonitis chiefly of purulent-fibrinous character; in two cases there were caseous changes. In all the animals it was a free, disseminated peritonitis. The mesenteric blood-vessels and lymph-nodes were enlarged, there were many adhesions between the intestines and a large amount of pus in the abdominal cavity.

These experiments prove conclusively, that it is possible to save the rabbits with peritonitis, by intra-abdominal injections of hypertonic glucose solution and to succeed even if the injections are first given twenty-four hours after the introduction of staphylococci.

A series of experiments proved that the amount of exudate in rabbits with peritonitis is approximately the same as in normal rabbits.

To meet the objection that the sugar has merely a nutritional value and the good results are not due to the osmotic action, we injected in two rabbits the same amount of glucose solution hypodermically. Both animals died within twenty-four hours. Thus a hypodermic injection of sugar was without therapeutic effect. Many blood smears were prepared; neither red nor white blood corpuscles showed any changes after glucose injections.

In two rabbits we produced an aseptic chemical peritonitis by injecting into each of them three c.c. of turpentine oil into the peritoneal cavity. One of these rabbits received afterwards the sugar treatment and survived, the other without treatment died in twenty-six hours.

We noticed that twenty-four hours after glucose injection no free liquid was found in the peritoneal cavity; the exudate must have been reabsorbed. The bacteria and their toxins are distributed through a greater amount of liquid when glucose is injected and they enter the blood stream more slowly, thus giving the organism more opportunity to counteract them. Therefore the animal recovers though the exudate is reabsorbed.

In addition to this the reabsorption causes the sugar to enter the blood-stream. We made many sugar determinations in the blood as well as in the peritoneal exudate, taking every possible precaution against disturbing factors such as narcosis, alimentary glycemia, etc. A specimen of the peritoneal fluid taken two hours after injection of forty c.c. 20 per cent. glucose contained 18.5 per cent. glucose; four hours after the injection we found 13.5 per cent. Corresponding to the diminishing sugar content of the peritoneal liquid we could notice a considerable elevation of the blood sugar level. The blood sugar content before the injection of glucose in one experiment was 0.06 per cent., four hours after the injection, 0.198 per cent., or more than three times the previous amount. In another experiment we found the following figures: Before the injection 0.07 per cent.; two hours after injection 0.147 per cent.; four hours 0.1 per cent.; six hours 0.204 per cent., or again about three times the previous amount; twenty-four hours after

glucose injection the normal sugar level was again reached. Urine analysis showed sugar absent or present in only negligible amounts, which proves that the sugar introduced was burned in the organism or transformed into glycogen and stored in important organs such as liver, heart, muscles, etc. The sugar tolerance was thus not exceeded; the assimilation limit was not reached.

The reasons why we used sugar solution and not any other hypertonic solution for our experiments are as follows:

1. Sugar prevents coagulation of the blood; thus the resorption of the liquid blood which may be found in the peritoneal cavity is made possible and the bacteria are deprived of an excellent culture medium in form of blood-clots. The sugar may also act as a prophylactic by preventing the formation of post-operative thrombosis.

2. Sugar counteracts the acidosis which develops following starvation and dehydration of the body by sparing the combustion of fat and proteins with the resulting formation of toxic acid bodies. When there is a lack of sufficient amount of carbohydrates, the toxic acid bodies are produced; the most obvious procedure therefore is to introduce into the body a carbohydrate as glucose that can most easily be burned.

3. Sugar possesses the power to divert the bacteria from the production of proteolytic enzymes and toxins. Abderhalden³² (cited by Kuhn) proved that all carbohydrates prevent in a greater or lesser degree the formation of proteases. The production of indol ceases when we add sugar to a culture of coli which contains albumen. Ochsner applies sugar to decomposing carcinomatous ulcers in order to prevent formation of offensive products of decay.

4. Sugar has certain bactericidal power. Reschke³³ noted that when sugar was added to a culture of streptococci, the number of colonies was less than in a similar culture without sugar and the hæmolytic zone was smaller. Neisser³⁴ found that the dissolving action of staphylococci on albumen is reduced by the addition of sugar. According to Heyrovsky³² (cited by Kuhn), pneumococci grow abundantly in sugar bouillon, but the cocci show signs of degeneration, bloating, discolor, etc., Pfeiffer,³⁵ Stern,³⁶ Panzini,³⁷ demonstrated that the peritoneal secretion destroys or prevents the multiplication of bacteria which are the usual inhibitions of the intestines, but has little or no influence upon the staphylococci and streptococci.

Kuhn³² established the fact that the sugar causes many bacteria, for example, *Staph. pyog. aur.*, *Bac. pneum.*, *Bact. coli*, *aerogenes* and others, to form acid products. The importance of this consists in the fact that the acid products are generally harmless and the alkaline are injurious and dangerous. Many germs cause fermentation of carbohydrates and production of lactic acid and when the supply of the carbohydrates is exhausted they decompose the peptones and form toxins, ptomaines and other injurious substances. In this way a supply of sugar prevents the production of these substances.

5. Sugar is a food easily assimilated and with a high nutritive value as well as a stimulant to the mechanism of cell metabolism, according to the results of experiments of Lusk,³⁸ Lennander, Tallerman³⁹ and many others

applied sugar by rectum and hypodermically to provide nourishment in serious cases. As pointed out, the sugar content of the blood increases as much as three times after intraperitoneal injection of glucose; practically no sugar is eliminated by the kidneys.

6. Due to its heavy, syrup-like consistency the glucose solution is a good mechanic isolator for the intestines, and in this way removes the greatest obstacle to permanent drainage, *i.e.*, the formation of adhesions and matting together of the coils of intestines.

Conclusion.—The most important factor in the treatment of acute free peritonitis is the prophylaxis. However, in spite of the advance of the medical science there will always be cases where peritonitis may develop, for example, post-abortive and puerperal peritonitis; typhoid, dysenteric, tuberculous, syphilitic, carcinomatous ulcers of the bowels, appendicitis, ulcers of stomach and duodenum, strangulated hernia, intussusception, penetrating wounds of the abdomen, etc.

In order to make the treatment of free peritonitis as physiologic as possible, that is to stimulate the natural function of the peritoneum, we experimented successfully in rabbits with intra-abdominal injections of hypertonic glucose (20 per cent.) solution. Since this method is absolutely harmless and gives encouraging results, we feel justified to suggest that this treatment be used in human beings in suitable cases. About 500 c.c. of 20 per cent. glucose solution would be the proper amount to begin with. The injections could be repeated through the drainage tube every six to twelve hours. Certain fundamental principles laid down for the treatment of peritoneal inflammation, notably by Fowler, Murphy, Ochsner and Crile, have to be strictly observed, namely, gastric lavages, Fowler's posture, permitting absolutely nothing to be put into the stomach, rectal feeding, introduction of liquids into the system by proctoclysis, hypodermoclysis or intravenous infusions, avoidance of purgation, etc. In addition to this at the end of the operation if such one is indicated we may pour the glucose solution into the abdominal cavity and repeat the injection through the drainage tube periodically.

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THE INFLUENCE OF HEMORRHAGE ON THE MORTALITY IN GUNSHOT WOUNDS AND OTHER INJURIES OF THE ABDOMEN—WITH AN ANALYSIS OF 69 CASES

BY JAMES MONROE MASON, M.D.

OF BIRMINGHAM, ALA.

THIS paper is based on a study of 69 cases of abdominal wounds which have been treated in St. Vincent's Hospital, the Hillman Hospital and the Employees Hospital of the Tennessee Coal, Iron and Railroad Company, during 1921 and 1922, with a few cases late in 1920. Eighteen cases have been treated in my own service; 27 cases are from Dr. Lloyd Noland's clinic of the T. C. I. Hospital; and the remaining 24 cases have been in the services of Doctors Ledbetter, Drennen, Davis, E. P. Hogan, G. A. Hogan, C. H. Moore, H. L. Jackson and Wilder, my associates on the staff of the Hillman and St. Vincent's Hospitals, all of whom I thank for the privilege of making use of case records.

With the exception of three farmers and one railway shopman, the patients have been unskilled laborers or members of their families.

There were 6 white patients and 53 colored.

Altercations, assassinations, or conflicts with officers of the law accounted for 52 cases, while one suicidal wound is noted, and 6 were attributed to accident.

The patients, as a whole, are of the most vigorous class of individuals, the greatest number being between the ages of twenty and forty, while there were four children under twelve years of age, and one man of sixty-three.

The cases were handled expeditiously; all but four reaching the hospital within a few hours of the time of the injury and undergoing operation without further delay than that necessary for examination, diagnosis, and surgical preparation. As far as the records show, all operative cases except seven underwent operation within eight hours after injury.

With these points in mind I feel that we are dealing with a series of abdominal injuries on healthy patients, who should be the best possible surgical risks, and who have been expeditiously treated, in well-organized hospitals, by skilled and competent surgeons, according to the best present-day surgical teaching.

While the series is not large, the statistics give a fair indication of what is being accomplished with this class of patients in civil life.

An analysis of the injuries sustained and the results obtained shows that the high mortality is not due to perforation or laceration of abdominal viscera, since all types of injuries were successfully treated by operation, but that it is due to the massive hemorrhage which is often associated with visceral injury.

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By early repair of the damaged viscera we save the patient from peritonitis, but, as the records show, we do not, with our present methods of treatment, compensate for the loss of blood which has taken place in certain cases.

TABLE NO. I

Classification According to Cause.

Crushing injury—rupture of spleen	1
Stab wounds	9
Gunshot wounds	59
Total	69
Deaths	41
Mortality	59.4

As stab and gunshot wounds present the same general type of injury, no attempt is made to provide separate statistical tables. Ordinarily, the stab wound is a less serious injury than the gunshot wound by reason of the more limited range of the knife as compared with the bullet.

The one crushing injury in the series is included in the "large hemorrhage" group and will be discussed somewhat in detail further on.

For purposes of closer study, the cases are further subdivided as follows:

TABLE NO. II

SUBDIVISION INTO GROUPS

Group No. 1

Large Hemorrhage Series

	Cases	Deaths	Mortality
"A" Cases not operated on by reason of collapse from hemorrhage when admitted:			
Gunshot wounds	9		
Stab wounds	1	10	100 %
"B" Operative cases. Large hemorrhage, with extensive visceral injury:			
Gunshot wounds	24		
Stab wounds	2		
Crushing injury	1	27	88.8%
Total	37	34	91.8%

Group No. 2

Small Hemorrhage Series

	Cases	Deaths	Mortality
"A" Operative cases. No material hemorrhage, extensive visceral injury:			
Gunshot wounds	17		
Stab wounds	2	19	31.5%
"B" Explorations: Wounds non-penetrating (5), or penetrating with no visceral perforation (8)			
Stab wounds	9		
Gunshot wounds	4	13	0.76%
Total	32	7	21.8%

Looking into these groupings, we find in No. 2, Group "B," 13 explorations with no visceral perforation and only one death. This death was in one of my own cases, and resulted from pneumonia from injury to the right thorax, and should not be charged to the abdominal injury. The low mortality shows the comparative safety of such explorations.

In Group No. 1 "A" we find 10 fatal cases in such collapse on admission that no operation could be undertaken. This demonstrates the desperate state which is quickly reached when large vessels are injured.

A comparison of the operative cases in Groups Nos. 1 and 2 gives interesting and startling information.

The patients in both these groups received the same class of visceral injuries, as is shown in Table III. They were treated in the same hospitals, with the same expeditionness, by the same surgeons, and under identical surroundings.

TABLE No. III
Visceral Injuries Sustained in Operative Cases

	Large Hemorrhage Series	Small Hemorrhage Series
Cases	27	19
Deaths	24	6
Mortality	88.8%	31.5%
Perforation or laceration of		
Bladder	2	3
Small intestine	14	10
Large intestine	7	5
Liver	7	3
Kidney	1	2
Stomach	7	3
Spleen	2	0
Mesentery	11	1
Simultaneous injury to other important structures:		
Spinal cord	1	0
Lungs and pleura	2	2

In one group we find a mortality of 31.5 per cent. and in the other a mortality of 88.8 per cent.

The great difference in the two groups is that on the one hand the injuries are unassociated with any material loss of blood, while on the other we have the addition of massive hemorrhage.

Injuries of the abdominal viscera will always have a certain unfavorable mortality from peritonitis, obstruction, and other postoperative complications, but a consideration of the case here presented shows that the extremely high mortality encountered is the direct result of hemorrhage, all the fatal cases in Group No. 1, except 8, dying within a very few hours, before sufficient time had elapsed for the development of fatal inflammatory or mechanical complications. The deaths, also, which took place later, were no doubt influenced by the lowered resistance from loss of blood.

All patients received the usual treatment for shock, namely, heat, opium, proctoclysis, hypodermoclysis, intravenous salines, and various cardiac stimulants. That these remedies are entirely ineffectual in overcoming the effect of large hemorrhage is demonstrated by the mortality of 88.8 per cent.

The brilliant results obtained by transfusion in all types of acute hemorrhage teach us that, if we are to lower this high mortality rate, donors must be obtained and transfusion must be practiced.

In only three cases of this series was transfusion resorted to, and one life was saved thereby.

The problem with this class of patients is the difficulty in securing donors. Patients are often friendless or out of touch with friends and family; such friends or acquaintances as sometimes accompany them are often ignorant, suspicious or afraid, and flatly refuse or disappear upon the suggestion that they act as donors. The patients and their friends are seldom able to pay donors for transfusion.

In the Hillman Hospital, which receives free patients from the city and county, in many years' service on the surgical staff, I have only been able to obtain two donors for immediate transfusion, though, on several occasions, when the emergency has not been so pressing, we have obtained suitable donors after some delay.

Every hospital that sets out to care for these injuries must be prepared to carry out, without delay, all the laboratory and operative detail of blood transfusion.

This demands that the laboratory staff be ready for blood matching at all times, and involves the typing of the blood of a large number of hospital employees who might consent to act as donors under certain circumstances.

The operating room service and the surgical staff should be so organized that patients may be transfused with no further delay than that necessary for procuring suitable donors.

This plan is in use in many hospitals that care for patients of better social and financial status, and while it will be difficult to put in operation with the cases under consideration, it should, nevertheless, be persistently attempted.

Transfusion should be considered as much a part of the treatment of these cases as the laparotomy, and when the surgeon and his staff consider the problem from this standpoint, an increasing number of donors will be obtained.

Auto-transfusion.—Auto-transfusion or auto-reinfusion of blood is a therapeutic measure of promise in a limited number of cases. This practice, introduced by Thies in 1914, and used first by Lichtenstein, in hemorrhage from ruptured ectopic pregnancy, was used in a small number of cases of traumatic hemorrhage in the recent war, and in a few cases from civil life.

Fieber,¹ Peiser² and Ranft³ report successful auto-reinfusions in ruptured spleen; two cases resulting from gunshot wounds, and one from the kick of a horse.

Elmendorf⁴ reports a successful auto-reinfusion of 300 c.c. of blood drawn from the pleura following gunshot wound of right thorax.

Kreuter^{5, 6} reports one successful auto-reinfusion in rupture of the liver caused by the kick of a horse, also one unsuccessful case in gunshot wound of the liver.

In the unsuccessful case he states: "The blood infusion was performed by an assistant during the operation. The patient was dying. The effect of the auto-infusion was marvelous. He recovered consciousness, but improvement lasted only a few hours. Autopsy showed that the patient died from progressive hemorrhage from an untreated wound of the kidney.

In hemorrhage from liver or spleen, and from mesenteric or other vessels, unassociated with contamination from injury to intestinal or urinary tract, auto-reinfusion is indicated and can be very easily carried out.

In this series there were three deaths from injury to the liver where it could have been employed. In one rupture of the spleen it could also have been used if a donor had not been at hand.

The brilliant results obtained in the small series of traumatic cases above referred to and in the more extensive experience of gynecologists, indicate that it is a therapeutic agent of great value in selected cases.

In our series only three transfusions were performed, one in Doctor Noland's clinic and two in my own service at the Hillman Hospital.

In Doctor Noland's case the patient was moribund following an operation for gunshot wound of abdomen involving the liver. He did not survive.

In one of my cases, a gunshot wound of the liver and right lung, patient died while transfusion was in progress, with symptoms of anaphylaxis, though the blood had been carefully matched in the laboratory.

My second case, rupture of the spleen, resulting from a wagon passing over the body of the patient, recovered.

I feel that the recovery of the patient was due directly to the transfusion. The case presents so many interesting points it will be briefly reported.

At 8 A.M., July 8, 1922, the patient, a white boy of fifteen, was run over by a wagon loaded with lumber. He was brought about 25 miles to the Hillman Hospital where I saw him at 8:10 P.M. His temperature was 99-4/5; pulse 84; blood pressure S. 115, D. 80; extensive abrasions were present over entire back, most marked over left lower ribs. There was no evidence of fractured ribs or of spinal injury.

His abdomen was rather rigid, and there was generalized soreness but no point of special tenderness. There was some suggestion of fluid in left flank. The urine was free from blood. He was suffering some pain across the upper abdomen and in his chest, but was not shocked.

His symptoms were so indefinite that we decided on further observation. The next morning he was again examined, Dr. E. P. Hogan being in consultation with me.

We found temperature 96-2/5; blood pressure S. 66, D. 42; pulse of 120. His abdomen was slightly distended, and signs of fluid were definitely present in the peritoneal cavity. He was pale and sweating, and complained of a feeling of great weakness.

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A diagnosis of abdominal hemorrhage was made, from rupture either of liver or spleen. It was evident that he would not survive an operation in the condition he then presented. His father was found to be a suitable donor, so we decided on a transfusion, to be followed by operation under local anesthesia.

Five hundred c.c. of citrated blood, together with 200 c.c. of normal salt solution, were given, and the blood pressure rose from S. 60, D. 42 to S. 80, D. 55 with a corresponding improvement in his strength.

Under .5 per cent. novocain the abdomen was opened through a right rectus incision. The liver was found intact. A large intra-peritoneal hemorrhage was present, and the spleen was found to be badly lacerated. As removal of the spleen was impracticable through the right rectus incision, the line of anesthesia was carried across the abdomen to the left; a transverse incision was made and the spleen was easily exposed.

Splenectomy was performed, and the abdomen was closed with a cigarette drain.

The operation was carried out under local anesthesia and the only pain complained of was that which attended the lifting of the spleen from its bed when the pedicle was clamped and ligated.

He made an uneventful recovery.

The other spleen case of the series, a gunshot wound involving spleen, stomach and right pleura, is in striking contrast to this one. He died on the operating table from the effects of hemorrhage, to overcome which no donor was available.

SUMMARY AND CONCLUSIONS

1. The mortality of 88.8 per cent. in the "Large Hemorrhage Series," as compared with 31.5 per cent. in the "Small Hemorrhage Series" teaches that our treatment of hemorrhage must be improved.
2. Transfusion must be more extensively employed.
3. Auto-reinfusion should be practised in selected cases.
4. If cases are seen early, and observation indicates that hemorrhage is not progressive, operation may well be deferred a short time, while waiting for reaction, and while efforts are being made to obtain donors for transfusion.

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END-RESULTS IN MALIGNANT DISEASE OF THE TESTIS*

By WILLIAM B. COLEY, M.D.

OF NEW YORK, N. Y.

IN a previous article, sixty-four cases of malignant disease of the testis were reported. Since then, there have come under observation fourteen other cases, making a total of seventy-eight. In this entire series, the great majority of cases were observed in the later stage of the disease, after recurrence had taken place, and the condition had become practically hopeless as regards a permanent cure. Only fifteen of the cases were seen during an operable stage, before there was any evidence of metastasis. Of these, the toxins were used as a prophylactic after operation in ten cases. Five were treated by operation without prophylactic after-treatment of any kind: one of these was an embryonal carcinoma which has remained well four years after operation; one died of metastases within a year of castration; and the other three cases have not been traced.

In the ten cases in which the toxins were used, alone in nine cases and combined with radium in one case after operation in the hope of preventing a recurrence, nine are living from three to fourteen years after operation; four are alive ten to fourteen years later. One of these cases, after remaining well for fourteen years, had a recurrence in the other testicle, which was removed by operation, and the diagnosis confirmed by microscopical examination (Table I). In addition to these cases, there are three others which were treated after a recurrence had taken place but before abdominal metastases had occurred, which recovered under the toxins alone, and the patients have remained well from five to twelve years (Table II).

Barringer¹ reported thirty-five cases of sarcoma of the testicle, nearly all of which had been treated with radium alone, and a few cases, with radium and X-ray. Of this series there was only one patient well over three years: a large, recurrent metastatic tumor of the abdomen, which entirely disappeared under treatment; and the patient was well at the time of last observation, three years and five months later. His report includes only three cases in which radium was used as a prophylactic measure after castration of a primary operable tumor of the testis; and of these cases, one remained well for nine months, one died, and one was not traced.

In a larger number of cases, abdominal recurrence had taken place which, under radium treatment alone, and in some cases under X-ray alone, showed marked regression. Barringer reported one case of remarkable regression; a large inoperable mass filling the right pelvis, which disappeared under a single radium pack application, and the patient remained well for three years and five months. In one case on my own service, a tumor the size of a man's

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head, practically entirely disappeared in the short period of two weeks under a single massive dose of radium; but about two months later, the tumor recurred and again nearly disappeared under radium; however, each succeeding treatment had less and less effect; and the patient died within six months from the time of the first treatment. These cases emphasize the fact that, in order to obtain a permanent cure in malignant disease of the testis, a proper form of treatment should be given at the time of the primary operation, before visible or palpable metastases have occurred; as there is little hope of obtaining a permanent cure after such metastases have developed.

Sarcoma of the testis occurs usually during the prime of life; and trauma has been noted as a probable causative factor in thirty-three and one-third per cent. of our cases.

Age: 1 case —20 months.
 2 cases between 15–20 years,
 20 cases between 20–30 years,
 32 cases between 30–40 years,
 12 cases between 40–50 years,
 3 cases between 50–60 years.

—
 Total, 70 cases.

The question of the pathology of malignant tumors of the testis has been exhaustively discussed by Ewing²; who in a careful microscopical study of nineteen cases of tumors of the testis, reached the conclusion that all such tumors had their origin in teratomas. Although there has been a gradual trend on the part of pathologists to accept in part the views of Ewing as regards the pathology of the majority of testicular tumors, few are willing to believe that all such tumors are of teratomatous origin. Chevassu, in his study of one hundred cases, classified only one as a teratoma, forty-seven as epithelioma seminal, fifty as mixed tumors, and the others as sarcomata.

One of the most important papers on the subject, published since 1911, is that of Schultz and Eisendrath,³ based on a review of the pathological diagnosis of microscopic sections of fourteen malignant tumors. They state that it is evident that there are still wide differences of opinion as to the origin and nature of tumors of the testicle; and that any histogenetic classification which attempts to include these diverse views must remain as complicated and unsatisfactory as most of the text-book classifications are to-day. Among the conclusions reached by these two authors are the following:

“For these tumors whose teratomatous origin is either definitely established by the presence of heterologous elements or is rendered very probable by the character of the atypical tissue, the designation embryonal carcinoma should be accepted. This term may be modified by the adjective hypoblastic, trophoblastic or epiblastic if the atypical tissue is glandular, syncytial or solid. Quite distinct from the embryonal carcinomas are the tumors of the solid, medullary, large cell type. The distinguishing characteristic of these tumors is the cell type. The tumor cell is morphologically identical with the younger

TABLE I.
Table of Cases of Malignant Tumors of Testis Observed in Operable Stage. End Results after Operation Followed by Prophylactic Toxins.

No.	Name	Age	Date	Duration	Pathologic diagnosis	Trauma	Post-operative treatment	End result
1	P. G.	51	June, 1907, operation, Dec., 1908	6 months size of closed fist	Round-celled sarcoma by Doctors Mandelbaum, Welch, and Ewing	No	Toxins of erysipelas given immediately after operation, for 3-4 months by Dr. Lillenthal	Patient well March, 1923, 14 years
2	R. M. M.	32	Operation, Oct. 7, 1912 by Dr. C. C. Kimball	3 months	Large round-celled sarcoma (Fig. 3).	No	Toxins begun soon after operation and continued for several months	Patient well March, 1923, 11 years
3	T. H. M.	28	Operation, Dec. 2, 1910, Mayo Clinic	4 months	Sarcoma	Yes Tumor 4 weeks later	Toxins begun soon after operation and kept up nearly a year. Temperature reactions 104°, highest dose 42 minims	Patient well 8 years later. Died of influenza, Nov. 21, 1918
4	D. E. B.	37	Operation, June, 1908 by Dr. John B. Murphy	Few mos. rapid growth	Round-celled sarcoma undescended testis, diagnosis confirmed by Dr. Ewing	No	Toxins begun as soon as wound healed and kept up with intervals of rest for six months	Well for 3 years, then developed metastasis in abdomen. Died at the end of 3 years and 9 months.
5	D. R.	44	Removal of right testis by Dr. J. A. Wyeth, 1899 1 year later recurrence in left testis	Few months	Round-celled right testis. Patient refused to have left testis removed	No	Toxin treatment for 6 months carried out under Dr. Coley's direction	Patient personally examined 8 years later and well 15 years later when last heard from.
6	J. P.	Adult	Removal Nov., 1910, Mayo Clinic	Few months	Sarcoma	?	Toxins begun soon after operation. Kept up 1 year	Well 7 years.

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7 T.	46	Feb. 23, 1906	3 months	Round-celled sarcoma	No	Toxins 1 month after operation. Recurrence in glands, inguinal and iliac, had taken place	Well 8 years later.
8 G. J.	37	Dec. 10, 1910 (Coley), size of orange	7 months	Teratoma typical, Dr. Ewing	No	Toxins after operation	Well 3 years; later.
9 W. M. H. ...	26	Operation, Feb. 1, 1906	3 months	Round-celled sarcoma	Yes soon after	Toxins begun 1 month after operation and continued for several months	Well Dec. 22, 1922, 17 years later.
10 L. G.	24	Operation, Nov. 2, 1917	3 months	Large round celled sarcoma. Report by M. Schiefel, Pathologist to Royal Free Hospital, London, confirmed by Dr. Ewing (embryonal carcinoma)	Yes 4 months before	Toxins Feb. 3, 1918, 1 dose radium-pack given March 18, 2nd pack Sept. 18, toxins kept up nearly 1 year	Patient well Feb., 1923, 5 years.
11 R. H.	20 months	1st operation, April, 1917, 2nd operation, June, 1917, 3rd operation by Dr. Coley, Oct. 19, 1917	3 weeks	Sarcoma of testis, Dr. Ewing (one of few cases Dr. Ewing has seen which he believes is a true sarcoma of testis)	Yes few months before	Toxins begun immediately after third operation (removal of very large, fungating tumor) toxins kept up 2 1/2 years with intervals of rest	Patient in good health, March, 1923, 5 1/2 years.
12 S. S. S.	42	1st operation, 1902, inoperable recurrence abdominal metastases, June, 1919	Recurred 1919, retroperitoneal tumor and large metastases in left suprarenal glandular pleura	Large round-celled sarcoma. Prof. of Pathology, Harvard Medical School	No	X-ray at Mayo Clinic, May, 1919, temporary relief. Tumor increased in size. Toxins begun July, 1919. Radium August, 1919. Treatment kept up 3 years	Patient well and free from all evidence of tumor, March, 1923, 3 years and 8 months.

TABLE I. *Continued*
Table of Cases of Malignant Tumors of Testis Observed in Operable Stage. End Results after Operation Followed by Prophylactic Toxins.

No.	Name	Age	Date	Duration	Pathologic diagnosis	Trauma	Post-operative treatment	End results
13	J. D.	32	Operation, Dec., 1908 (Coley)	?	Carcinoma (Ewing)	No ? possible trauma from truss	No toxins. Only case in entire series well 4 years after operation alive	Well 4 years later.
14	E. L. F.	42	Operation, Nov. 22, 1907, Dr. C. A. Porter, Boston	3 months	Round-celled sarcoma	No	Toxins begun 3 weeks after operation given by Dr. Faulkner under Dr. Coley's direction	Patient well 14 years. Then had recurrence in other testis, removed, diagnosis confirmed by mic. ex.
15			Recurrence in iliac and abdominal glands	Inoperable recurrence	Round-celled sarcoma		Toxins, apparent complete disappearance of tumor	Well 3 years, then died of recurrence.
16	?	43	1st operation 1910, 2nd incomplete operation in August, 1910, by Dr. Percy Shields	Inoperable recurrence	Round-celled sarcoma	No	Toxins after second operation, glands disappeared, treatment continued for 1 year	Well 10 years later.

Note:—In three cases the condition was inoperable metastatic recurrence and in two others the toxins were used after 2nd or 3rd operation for recurrence.

TABLE II.
Inoperable Cases Treated with Toxins by other Surgeons.

Name	Age	Date	Duration	Pathologic diagnosis	Trauma	Post-op. T.	End results
Case of Dr. Robbins. Reference, Himmelman, Jour. A. M. A. Dec. 5, 1914	55	1st operation, Jan., 1909, 2nd operation, 15 days later, recurrence		Sarcoma	?	Toxins	Disappearance of tumor. Patient remained well for 4 years and then died of nephritis. No evidence of old trouble.
Case of Dr. William Maibon, Manhattan State Hospital, personal communication		Testis removed in 1899, recurrence in tongue five years later		Testis, sarcoma, tongue, round-celled sarcoma, Dr. William H. Welch		Toxins	Well 15 years later.
Case of Dr. Hertel of Copenhagen, reference, Hospitals-tidents, April 7, 1909	29	3 recurrences, 3rd operation was Lennander's operation (incomplete)		Sarcoma		Toxins	Glands disappeared. Patient well 10 years.

cells of the spermatogenic cycle and is probably derived from the cells of the seminiferous tubules. For this kind of tumor the term spermatocytoma is suggested."

One has but to note the pathological reports on malignant tumors of the testis made at the various laboratories, and the various reports published in the literature, to become impressed with the great confusion that still exists in the classification of these tumors. For example, Bulkley⁴ in his report on fifty-nine collected cases of tumor of the undescended testicle, gives the diagnosis as sarcoma in one form or other in forty cases; the remainder being: teratoma, two; epithelioma, two; chorio-epithelioma, two; carcinoma, seven; rhabdomyoma, one; and cancer, five. Sakaguchi,⁵ in studying thirty-two cases of malignant tumor of the testicle, groups his cases as follows: sarcoma, one; typical large cell tumors, twenty-one; atypical large cell tumors, two; epithelial tumors, seven; and one tumor with adenomatous areas and also solid cell nests. Tanner⁶ classifies the malignant tumors of the testicle into two main groups, as follows: "1. Carcinomatous; large cell, large nucleus type, undoubtedly closely related to 2. Mixed tumor type: (a) Tumors containing cartilage, cysts, glands, etc.; (b) ordinary glandular structure tumors; (c) chorio-epithelioma."

In the present state of uncertainty as regards classification, we believe it is wise to group all cases of malignant disease of the testis under the general heading of cancer of the testis, as is done by Chevassu,⁷ subdividing the different varieties as far as our knowledge permits, into: (1) teratoma, to include the mixed type of tumor, containing cartilage, cyst, glands; (2) embryonal carcinoma, to include the pure solid tumor, may or may not be of teratomatous origin, of the large-celled, large nucleus type; (3) the rapidly diminishing group of pure sarcomata.

End-results Following Surgical Treatment.—In a former paper⁸ the opinions of various surgeons here and abroad, as to the curability of malignant disease of the testis by operation, were referred to at some length. Most of the authorities were uniformly pessimistic. There are no statistics, apparently, on which to base an opinion as to the end results following the combined operation of removal of the testis and the retroperitoneal glands by abdominal operation, except those of Hinman⁹ and Chevassu. The mortality of eleven per cent. in forty-four collected cases, is sufficient to make one hesitate to adopt this operation until better end results have been obtained. Forty-one per cent. of these cases died at the end of one year. Hinman's statistics represent, probably, the most accurate estimate of the best end results that can be expected of modern surgery alone. Of twenty-four cases traced, of his series of thirty-two, twenty had died and four were living. As regards the pathology of eighteen cases in which the specimens were carefully examined, nine were pronounced pure round-celled sarcoma, and nine teratoma. Of the nine round-celled sarcomas, two are living, one twelve and the other thirteen years; of the latter group (teratoma) only one patient is living, sixteen months. Of seven patients treated elsewhere, only one was living

twelve years later. It is interesting to note that of all the patients who died, none lived for a period of two years; in other words, only three of this group lived longer than three years (about ten per cent. of the total number).

He brought out the very important point that although in only two per cent. of the forty-four cases were the glands palpable at the time of the operation, yet the abdominal operation revealed the fact that in fifty per cent. of the cases, the retroperitoneal glands were involved with the tumor. This would explain why the simple orchidectomy in the past has cured so few cases. Another important fact brought out by Hinman is, that of eight cases in which no glands could be found at the time of the abdominal operation, three later died of cancer. Of the forty-four cases collected, twenty were living at the time of his report, nine over two years, an average duration of one year and eight months. The longest period of freedom from recurrence after operation was four years and ten months in one case.

While sufficient time has not elapsed to determine the number of permanent cures following radical operation, Hinman's statistics show beyond question, that the prognosis can be materially improved by the abdominal operation; but this can only be obtained at the expense of a mortality of eleven per cent. against a mortality of nil following the simple orchidectomy operation. In a second article including five additional cases, Hinman⁹ concludes that:

"1. The radical operation for teratoma testis is justified in suitable cases by the high mortality following simple castration; by the definite experimental and surgical demarcation of the primary lymph zone, and by the possibility of the clean and complete removal of this zone.

"2. The radical operation is neither technically difficult, dangerous nor mutilating, as is proven by the fact that it has been successfully performed and the primary lymph zone completely removed in five cases of teratoma testis without a single troublesome operative or post-operative complication.

"3. These five surgical successes indicate that the mortality from this seemingly extensive operation should be little if any greater than that following castration. All five cases enjoy perfect health now nine months, seven and one-half months, four months, three months, two months, and three years and six months, respectively, since operation.

"4. The ultimate result in these five cases cannot be known for years. But the finding in four cases of metastatic tumor tissue in the lymph areas radically removed demonstrates the uselessness of simple castration and the necessity of radical surgery. A cure in any one of the four certainly, and possibly of the fifth, will have been directly due to the early and clean removal of the gland-bearing area."

Tanner¹⁰ basing his report on a study and analysis of one hundred and one cases classifies the tumors in ninety-seven of the cases as malignant, four as benign, thirty-five as mixed or embryoid, and sixty-two as of the soft, cellular, medullary type. He states: "Out of six hundred cases collected which were operated upon, four hundred and sixty-five were followed. Of

these, three hundred and seventy-seven, or eighty-one per cent., were dead; while only twenty-five, or five and one-half per cent., were found to be living and well four years or more after operation." Of Tanner's series of twenty-two mixed tumors, only two were alive over three years; and of the ten tumors found to contain cartilage, all but one case died. Of the sixty-two cases of carcinomatous type, fifty-four were traced, of which twenty-five had died and thirty-one were living, fifteen beyond four years or more after operation, and three over ten years after operation. The statement in reference to my earlier paper ⁸ that, in fifty-two cases of my own series, the toxins were used after castration as a prophylactic, is a serious error. That study was based upon a series of sixty-four cases, a complete tabulation of which was made at the end of the paper. He assumed that the toxins were used as a routine measure in all of these cases when, as a matter of fact, they were used in only nine cases as a prophylactic and this was so stated.

In his series there were only six cases in whom the toxins were used as a prophylactic after operation; four of these have died, and two are living from seven to nine years after the operation. He adds that, "these two were both of the so-called carcinomatous type of tumor, and about thirty-three per cent. of them are cured by simple castration alone." This is hardly supported by Tanner's own statistics, *i.e.*, of sixty-two cases of the carcinomatous type, thirty-one were living at the time of the report, only seven of which had remained well upwards of seven years, which would make the percentage eleven instead of thirty-three, treated by castration alone. He gives us, however, the first data on which we can base conclusions as to the prophylactic value of radium or X-ray, singly or combined, when given immediately after operation in operable cases. Stating that: "In this series eleven patients received X-ray or radium treatments following castration. X-rays alone were used in seven cases, X-ray and radium in three cases, and radium alone in one case.

RESULTS OF CASES TREATED BY X-RAY

- 2 living and well 4 years after operation,
- 1 living and well 3 years after operation,
- 1 living and well 2½ years after operation,
- 1 died 3 months after operation,
- 2 died 7 months after operation.

Total, 7

RESULTS OF CASES TREATED BY X-RAY AND RADIUM

- 1 living and well 1 year after operation,
- 1 died 3 months after operation,
- 1 died 7 months after operation.

Total, 3

RESULTS OF CASES TREATED BY RADIUM

- 1 living and well 6 months after operation.

From these statistics it is seen that five out of eleven patients are dead, and out of the six who are still alive, only one patient is living over four years. Adding to the above, the three cases which Barringer treated with radium as a prophylactic after operation, one well nine months, one dead, and one not traced, we have fourteen cases, of which only one remained well beyond the period of four years, and two beyond three years. A comparison of these results with those obtained by the use of toxins as a prophylactic after operation, would lead one to the conclusion that the latter agent was of greater prophylactic value.

In view of the fact that such a small proportion of cases have been permanently cured by operation alone, it would seem difficult to explain the freedom from recurrence for such a long period in the present group, on the ground of coincidence. It would seem more fair to conclude that the toxins have an inhibitory action on the growth of the tumor cells, in many cases sufficient to prevent their further development, and in other cases, to postpone their activity for a long period of time. This conclusion is further strengthened by a number of cases in which recurrent tumors, whose malignant nature is unquestioned, have disappeared, and the patients have remained well for a considerable period, finally developing other recurrences which have proven fatal. In these cases, the inhibitory action of the toxins is absolutely demonstrated; but for some unknown reason, it has not remained sufficiently powerful to effect a permanent cure.

If we had no alternative, we might be forced to admit that radical or combined operation should be the method of choice in malignant tumors of the testis; but in our opinion, we have an alternative, which should be seriously considered before resorting to such a serious procedure. Since the publication of Hinman's paper, radium has come into much more general use; and the methods of applying it have been greatly improved. So far we have no large series of cases in which radium has been used immediately after removal of the testis for malignant disease. In such a condition, immediate post-operative radium or X-ray treatment, we believe, will give better results than orchidectomy alone. It was even hoped that by the use of large doses of radium, we might be able to treat successfully the recurrent abdominal cases; but Barringer's experience in nearly fifty cases of recurrent inoperable malignant tumors of the testis which have been treated by radium therapy, has demonstrated otherwise. We have learned that by massive doses of radium, administered in the form of a radium pack, we could, in most cases, produce very marked regression of a large retroperitoneal tumor and in a considerable number of cases, cause its complete disappearance. Yet in practically all of the cases, with one exception, the disappearance or improvement has proven only temporary. Therefore, as far as our present knowledge goes, we must admit that we are unable to offer much hope of a cure if the disease has metastasized in the abdomen sufficiently to produce large and palpable tumors.

The present series of cases show that even better results than those

reported by the combined radical operation advocated by Hinman and Chevassu, can be obtained by simple orchidectomy if the operation is immediately followed by prolonged systemic toxin treatment, with or without radium. We believe that the best results are likely to follow the combined use of massive doses of radium over the abdomen and left supraclavicular glands, and prolonged toxin treatment. Another point worthy of special emphasis is, that these results have been obtained without any mortality.

Method of Toxin Treatment.—This should not be employed at all unless the patient is willing to have it kept up for a considerable period of time, at least six months. It can be carried out at home by the family physician, and need not interfere with the patient's ordinary routine of living. The injection should be made deeply into the buttocks, beginning with a dose of one-half minim, diluted with a little freshly boiled water, and increased daily by one-half minim up to the point of producing a slight reaction, temperature of 99 to 101 or 102 degrees. It should then be given only three times a week, increasing the dose only if necessary, to the point of a moderate reaction. At the end of three months, it is safe to diminish the frequency of the injections to two a week, using doses just large enough to produce slight reactions.

In all cases where it is possible, either radium or deep X-ray therapy should be used in addition, covering the entire retroperitoneal glandular region on the side of the tumor. We believe it wise to repeat these treatments at the end of four to six months. So essential is long-continued treatment, that the introduction of the subsequent history of the appended case (originally reported in full in *Trans. So. Surg. Assoc.*, 1917) will be most germane.

CASE I.—R. H., twenty months of age. Trauma a few months prior to appearance of the tumor which was first noticed in May, 1917, in the left testicle. This grew to the size of an orange in three weeks. The testicle was removed at this time by Dr. D. P. Murphy, of Elmira, N. Y. Three weeks later a recurrence took place, of very rapid growth, with involvement of the glands of the groin. A second operation was performed by Doctor Murphy about two months after the first one. This, also, was followed by a rapid recurrence of still more rapid growth. The patient was brought to me on October 19, 1917, and admitted to the Memorial Hospital. Physical examination at that time revealed a very large tumor, the size of two fists, extending down the thigh for a distance of six inches, the lower third of which was a fungating mass with foul smell and discharge. The tumor, which did not extend upward beyond the external ring, was removed, and the wound closed with skin from the other side of the scrotum. The patient was immediately put upon the mixed toxins of erysipelas and bacillus prodigiosus (no other treatment).

Pathological report by Dr. James Ewing (December, 1917): "The specimen is a round, solid, soft, elastic tumor mass, 7 x 8 cm.; it fungates through the skin over an area of 4 cm. wide, a portion of skin accompanying the specimen. On section the tumor is smooth, translucent, hemorrhagic along the fungating edge. It is circumscribed by an indistinct capsule. No portions of the testicle are visible in the single gross section. On microscopic examination the structure is composed of large and small groups of large polyhedral and spindle cells of indifferent embryonal type, consisting chiefly of hyperchromatic nuclei. These cell groups

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grade off into an abundant mucinous tissue of myomatous type and every gradation from polyhedral to star-shaped cells may be followed. Some cell clusters surround blood-vessels, which are not numerous. There are scanty small points of necrosis. The diagnosis is embryonal carcinoma of testis, with transition to pseudosarcomatous structure." Doctor Ewing, recently reviewing this case stated, that the diagnosis "embryonal carcinoma," given in his report, was an error, and that he regarded this as one of the very few cases in which he would make a definite diagnosis of sarcoma of the spindle- and round-celled type. (Fig. 1.)

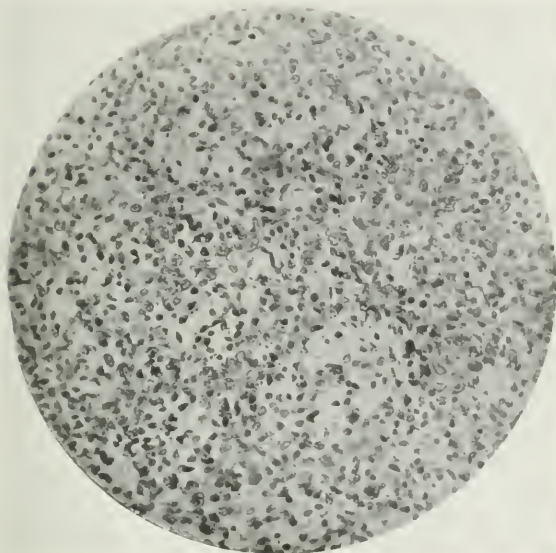


FIG. 1.—Three pieces of the original and the spindle-celled sarcoma of the testis, twenty months old. Toxins given after last operation. Patient in good health, over five years later. (Case XI in table.)

The toxins were given for about two weeks and later continued at home by the family physician, to whom it was suggested that the treatment be kept up for a considerable period. At the end of a few months, however, the patient was so well that the treatment was discontinued. About a year and a half later, another nodule the size of a pea, appeared in the neighborhood of the scar. This was removed and pronounced by Doctor Ewing to be of the same structure as the original tumor. The toxins were then resumed and kept up for an even longer period than before. At the present time, five years after the last operation, the patient is in excellent condition with no trace of a recurrence. In this case, in view of the very rapid recurrence after two operations alone, I think it is only fair to assume that the toxins which were given after the third operation played an important part in the final recovery of the patient.

Appended is a detailed report of two recent cases which are of interest.

CASE II. *Recurrent Inoperable Metastatic Sarcoma of Testis, Treated with Toxins and Radium. Well four years.*—S. S. S., forty-two years of age, was operated on for sarcoma of the right testis by Dr. M. J. Seelig, of St. Louis, in 1902. A diagnosis of round-celled sarcoma was made at the University laboratory, and section of the tumor sent to the Professor of Pathology at the Harvard Medical School, who confirmed the diagnosis. The patient remained well until 1918, when he had occasional attacks of cramps in the groin on the right side. It was thought

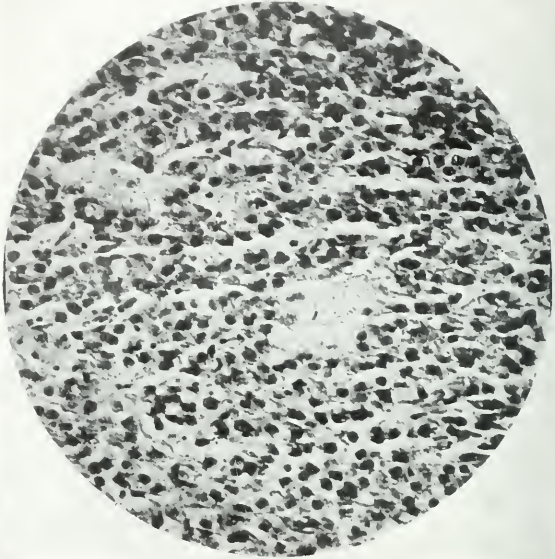


FIG. 2.—Round-celled sarcoma of testes, diagnosed by Doctor Ewing as embryonic carcinoma. Toxins shortly after operation; continued for one year; one radium application over abdomen in March, 1918, and another in September, 1918. Patient well nearly five years. (Case X in table.) (Case III.)

at first that the condition might be due to chronic appendicitis. He went to the Mayo Clinic in May, 1919, and the physical examination report at that time stated: "The large tumor in the abdomen is probably a recurring sarcoma involving the deep glands along the spine. This growth apparently is not attached to any organ. General condition is good." He was put upon X-ray and radium treatment at the Mayo Clinic and under this the tumor subsided considerably. Shortly after returning home, the tumor again began to increase in size, his abdominal symptoms recurred, and another tumor developed in the left supraclavicular region. The patient was referred to me by Dr. Charles H. Mayo in July, 1919, for advice and treatment. Physical examination at this time showed a large tumor in the right lower abdomen, apparently retroperitoneal metastases from the primary tumor of the testicle.

MALIGNANT DISEASE OF THE TESTIS

The left supraclavicular region was occupied by a tumor about the size of a hen's egg, apparently another metastatic growth from the primary sarcoma of the testis.† The patient was admitted to the Memorial Hospital and treated with systemic toxins alone. After two weeks' treatment, the mediastinal tumor had diminished to one-third its original size and the tumor in the abdomen had also decreased appreciably. He was then given a massive dose of radium over the left abdomen, and the radium pack was placed on the left supraclavicular tumor. In about three weeks, the supraclavicular tumor had entirely disappeared and the tumor in the

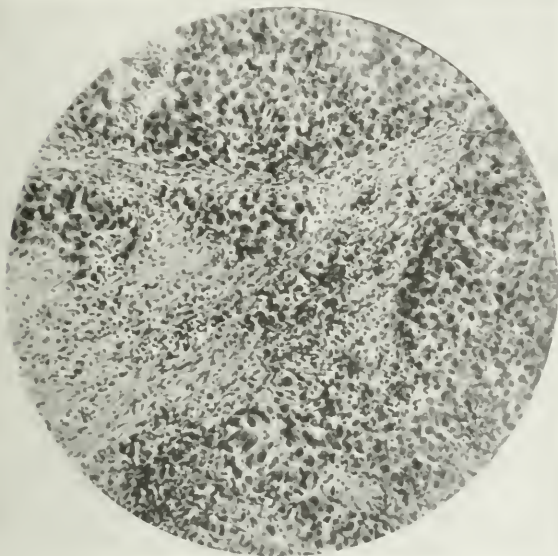


FIG. 3.—Large round-cell sarcoma. Tissue removed after operation, prolonged treatment. Patient cured of the tumor.

abdomen had steadily decreased in size. The patient returned home where the toxins were kept up for six months, at the end of which time he returned for further radium treatment. Examination failed to reveal any tumor mass in the abdomen or supraclavicular region. Another radium treatment was given over the abdomen, and the toxins were further continued. He has come on for observation every six months, during the first two years, and once during the last year. A careful examination in the fall of 1922 failed to reveal any visible or palpable evidence of any tumor, either in the neck or in the abdomen. After remaining well for three and one-half years, in early January, 1921, he had what was supposed to be an attack of grippe, followed by a pleuritic effusion.

† The author has seen four cases of metastases in the left supraclavicular region following a primary sarcoma of the testis. The explanation is, that the thoracic duct, which drains the abdominal and lymphatic glands, empties into the left subclavian vein.

He has had four aspirations of one-half to three and one-half quarts of chocolate colored sterile fluid. No evidence of metastases of the lungs can be determined by X-ray pictures or fluoroscopic examination. He is well April 1, 1923.†

CASE III. L. G., twenty-four years of age, was referred to me by Dr. M. Murray, of Hessle, East Yorks. England, on February 12, 1918. Previous History: The patient served as an officer in the British Army since January, 1915. He was severely wounded in October, 1915, an artery being cut, for which the right leg was immediately amputated. In April, 1917, he was struck in the left testis by a tennis ball, following which there was severe pain, but no swelling until August, 1917, or three months after the injury. The testis was removed on November 2nd, and the patient remained in the hospital for ten days. His general health was fair; had lost some weight.

Pathological report, by M. Schofield, M.R.C.S., Pathologist to the Royal Free Hospital, London, December 17, 1917: "Macroscopically, the specimen consists of a large, firm, oval tumor, measuring $4\frac{1}{2}$ inches long and $3\frac{1}{2}$ inches wide, by 3 inches thick, distending the cavity of the tunica vaginalis and partly adherent to the latter. The cord is attached to the upper and posterior part of the mass. The cut surface is firm and reddish-brown in color, except for an irregular, yellow, friable portion in the centre evidently necrotic. Microscopical sections show a dense cellular growth composed of large round cells, invading and entirely replacing the normal tissue of the testis. There is a marked chronic inflammatory reaction, especially at the spreading edge of the growth. In some parts the cells are very degenerate and the tissue completely necrosed, but in other parts many of the nuclei show mitotic figures indicating rapid growth. The appearance is that of a large round-celled sarcoma. Sections through the cut end of the cord show no malignant cells."

Physical examination at the time of my first observation, February 12, 1918, showed a patient rather thin but not emaciated, with good color. Examination of the groin and abdomen showed no palpable evidence of metastases. He was put upon the mixed toxins of erysipelas and bacillus prodigiosus, beginning with a dose of one-third minim and increasing up to the point of producing a marked reaction. The patient was very susceptible to the toxins, getting a temperature of 104° from three minims. He was never able to take over three to four minims during the entire course of treatment. In March, 1918, a massive dose of radium was applied at the Memorial Hospital, over the abdomen, two areas, 6207 mc. hours in each, at a distance of 6 cm. This produced intense nausea which lasted for several days. The toxins were continued with occasional intervals of rest. On September 17, 1918, a second application of radium was given over the same areas (upper and lower portion of the left abdomen), a total of 14,439 mc. hours at a distance of 10 cm. The patient then returned to England, where the toxins were kept up with occasional intervals for a little more than a year from the time the treatment was begun. The patient has remained in good health up to the present time with no evidence of a recurrence, four years and ten months later. In this case the slide was submitted to Dr. James Ewing, who pronounced it malignant of the type which he designates embryonal carcinoma. (Fig. 2.)

CONCLUSIONS

The number of permanent cures following surgical removal of the testicle for malignant disease, is comparatively small, the proportion being not over five to ten per cent. This number of cures, in our opinion, is not sufficiently

† Examination made July 25, 1923, showed patient perfectly well. No tumor in abdomen and X-rays of chest showed lungs normal.

increased by the radical operation of removal of the retroperitoneal glands by the abdominal route, to warrant the very considerable risk of such an operation.

Long-continued systemic treatment with the mixed toxins of erysipelas and bacillus prodigiosus, combined with thorough radiation of the abdomen and supraclavicular glands by radium or X-rays, offers a far better hope of a permanent cure than any form of operative treatment alone.

If one waits after operation until a recurrence has taken place, marked regression of these recurrent tumors, and in some cases complete disappearance, may be expected from radium treatment; but in the great majority of these cases, the regression or disappearance will prove only temporary and death from extension of the disease will occur.

Since this paper was read, further evidence of the value of the mixed toxins as a prophylactic after operation has been presented by Brickner (American Journal of Surgery, May, 1923); his report describes a man, forty years of age, who was operated on at the Mt. Sinai Hospital by Doctor Brickner on April 25, 1912. The tumor was of several weeks' duration, and was the size of a tangerine orange when removed. Three days later, an orchidectomy was performed, and the cord and testicle with its covering were removed *en masse*. Pathological examination by Dr. F. S. Mandlebaum: "a perithelial sarcoma, chiefly of large round cells, with pronounced evidences of malignancy." The mixed toxins of erysipelas and bacillus prodigiosus were administered from April 30 to June 18, 1912 (20 injections in all, the highest dose, 5 minims, producing a reaction of 100-01°). At the time of writing, the patient was in perfect health with no sign of a recurrence, eleven years later.

While in London in 1911, the author (Doctor Coley) saw in consultation, a young man, seventeen years of age, suffering from a large sarcoma of the testis, for which he advised immediate orchidectomy followed by toxin treatment. This was carried out, but no further report of the case was had until May, 1923, when he was again in London and saw the surgeon who had performed the operation; he then learned that the patient was still in good condition, twelve years later. The diagnosis in this case was confirmed by microscopical examination.

A personal communication just received from Dr. James T. Pilcher, of Brooklyn, mentions the end result of a case of tumor of the testis operated on by Doctor Pilcher in 1913; diagnosis by Doctor Murray of the Hoagland Laboratory of Long Island College Hospital: degenerate teratoma with both sarcomatous and carcinomatous degeneration; Doctor Lederer (Pathologist of the Jewish Hospital of Brooklyn) regarded it as a myxo-sarcoma of the testicle. This patient has remained in good health up to the present time, nine and one-half years later, without any prophylactic treatment following the operation.

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EMPYEMA OF THE URETERAL STUMP FOLLOWING INCOMPLETE URETERECTOMY

BY ABRAHAM HYMAN, M.D.

OF NEW YORK, N. Y.

THE literature dealing with the fate of the diseased ureter following nephrectomy is very scant, but few references having appeared on this subject. Recently, in a comprehensive article, Latchem,¹ of the Mayo Clinic, undertook, by animal experimentation, to study the question. A number of interesting observations were made which may be briefly summarized. Following a nephrectomy in which a normal ureter remained, it was found, that after a period of time averaging a little over a year, there was no tendency shown towards obliteration of the lumen of the ureter. There was, however, a distinct atrophy of its muscular layer. "The results obtained in the hydro-ureters and pyo-ureters depended entirely on whether or not the ureteral contents were evacuated. With drainage, the distended ureter became smaller through collapse of the lumen and atrophy of the muscle coat, and peri-ureteral inflammation did not occur. When obstruction to drainage was present, the muscular hypertrophy remained, and absorption of the ureteral contents seemed very limited, if occurring at all. Infection of the ureteral contents, if not present at the time of nephrectomy, occurred later in some instances, and always spread through the ureteral wall, to cause peri-ureteritis." Peri-ureteritis was present in every pyo-ureter in some degree, varying from inflammatory adhesions to abscess formation.

Judging from the scattered case reports, surgical interference for pyo-ureter is infrequently required. This may be due to the fact that the obstruction at the lower end of the ureter is seldom complete enough to prevent drainage of its contents. Israel² operated for this condition four times in a series of nine hundred kidney and ureter operations. Fowler³ and the Mayo Clinic⁴ have reported additional cases. Undoubtedly, a more extensive search of the literature would bring to light other such instances.

The condition which at present interests us differs somewhat from the ordinary pyo-ureter. It is in reality an empyema of the ureter stump which is occasionally left behind, following a ureterectomy. The term ureterectomy implies a removal of the entire ureter, down to its entrance into the bladder. A complete ureterectomy, however, is seldom performed; the lower inch or two of the vesical end of the ureter, the most difficult part to resect, being frequently left behind. The stump of ureter remaining may, when diseased, cause as much or more trouble than the major portion which was excised. The clinical course, and the cystoscopic picture of this condition, is in many respects, analogous to that of an infected vesical diverticulum, and the surgical treatment presents practically the same problem. The diagnosis of pyo-ureter of the ureteral

stump may offer some difficulties on account of its infrequency, and the inability to properly interpret the clinical and cystoscopic findings. The sequence of events is generally as follows: After a nephrectomy for a non-tuberculous renal suppuration, the pyuria persists, in fact may become more pronounced than it was prior to operation. Cystoscopy demonstrates that the pus comes from the dilated ureter. A ureterectomy is then performed, despite which the pyuria remains practically unchanged. Now unless a careful cystoscopic study is made, the source of the pus may be overlooked, for it is not generally recognized that the ureteral stump, left *in situ*, can be the cause of all the trouble.

The local pathological findings in our three cases may be thus summarized. The ureter stump, firmly embedded in dense adhesions, was found considerably thickened, and the walls infiltrated, as a result of which a marked peri-ureteritis was present. The ureteral lumen was considerably dilated, forming an elongated pouch, the contents of which consisted of thick pus which was extruded through the orifice, in tape-like pieces. In one case, besides the pus, there was found a considerable amount of calcified material. The ureter meatus in these three cases was almost occluded; in two instances, by a very pronounced inflammatory oedema, which completely obliterated the orifice from view, in the other case, the orifice was markedly contracted. The meatus in the first case was fibrotic, and so dense that it could not be cut through with the cystoscopic operating scissors. These findings correspond very closely to those reported by Latchem, in his animal experiments, and tend to corroborate clinically, his conclusions, that the lack of proper drainage, through the ureteral meatus, prevents emptying of its contents, and serves to prolong the suppuration indefinitely.

Clinical and Cystoscopic Features Noted in Three Cases.—The subjective symptoms are those of a pronounced cystitis. The urine, however, is more turbid and purulent than is usual in even a severe cystitis. Radiography of the urinary tract may reveal, as in one case, calcification within the ureter stump. Cystoscopic examination enables one to make an exact diagnosis. The ureteral orifice in all three instances was obstructed sufficiently to interfere with drainage. As a result, in one case, there was no pus observed coming from the meatus, and had the stump not been catheterized, the condition might very well have been overlooked. On introducing the catheter and on manipulating it in the stump, there was noted on its withdrawal, an escape of thick pus through the meatus, in the shape of a ribbon. The ureteral orifices could be catheterized only with the greatest difficulty, once on account of the marked oedema surrounding the meatus, in another instance the orifice had contracted to such a degree that it could only be identified by massaging the stump through the rectum, thus forcing out large clumps of pus. In two of the cases, the ureter catheter was introduced a distance of 6-8 cm., in the other over 25 cm., when a radiogram demonstrated that this was due to the fact that the catheter had coiled up on itself a number of times. At no time was peristaltic action of the meatus noted, although such an instance has been reported.

Radiograms taken with an opaque catheter in the stump, or after injection with bromides, show very distinctly the size and contour of the ureter.

The only satisfactory treatment is surgical, unless there are contraindications. Whenever possible, the stump should be excised. Its presence as a suppurating sac may in time lead to infection of the other kidney. This undoubtedly happened in the first case of our series. Palliative treatment consists in repeated dilatations of the meatus, or better still, the orifice may be divided with the operating scissors, or burnt through by fulguration; thus better drainage may be secured. At this point it may not be amiss to bring up the question of the proper disposition of the ureter, during the course of a nephrectomy for non-tuberculous affections. If the ureter is found but moderately diseased without evidences of any stricture, excision will not be necessary. A dilated, thickened infected ureter, especially if obstructed at its lower end, should be extirpated. It is very important that the entire ureter be excised, down to its entrance into the bladder, otherwise the stump left behind may continue to suppurate as in the cases under discussion.

Operative Technic.—It must be borne in mind that the extirpation of an ureteral stump is generally a difficult surgical procedure. The exposure of a deep one, the ureter as a result of the previous operation and the peri-ureteritis is firmly embedded in the pelvis, closely adherent to the iliac vessels. The danger of a severe hemorrhage under such conditions is very great. There are two methods of approach, the first consists in mobilizing the bladder completely and then exposing the ureter, as is done in the operation for resection of the bladder for malignancy. The adhesions may be so dense that it may be impossible to obtain an exposure by this route. The second method is to open the bladder, introduce a probe through the diseased orifice, and identify the ureter in this manner. The former procedure is probably the better one, the incision being the usual one employed for the extra-peritoneal exposure of the ureter. To facilitate dissection of the ureter, it will be found advisable to start from below, that is, from the uretero-vesical juncture, where it is likely to be less diseased and less adherent, and gradually work towards the upper end of the stump. When the latter is firmly attached to the iliac vessels, it may be advisable to resect only a short piece. Under these circumstances, as much of its anterior and lateral wall as possible should be removed, the mucosa of the remaining portion thoroughly curetted and carbolized. A suprapubic cystotomy should complete the operation; this will diminish the danger of leakage through the ureteral orifice, with consequent infection of the peri-ureteral tissues.

The following three cases of empyema of the ureter stump have been observed during the past ten years:

CASE REPORTS

CASE I.—M. M., age forty-six, male. Admitted to Mt. Sinai Hospital (service of Doctor Beer), May, 1912, with the following history. Nine years ago his right loin was incised and a perinephric abscess drained. The sinus refused to

close, and a few months later, a right nephrectomy for pyonephrosis was performed. Following this operation, a suppurating lumbar sinus persisted, and the urine remained very turbid; to cure this condition, a ureterectomy was performed. The ureter was difficult to locate on account of the dense adhesions. It was markedly thickened and dilated, and resected down to within a very short distance of its entrance into the bladder. Packings were freely used for drainage and to control bleeding; on removing these a fecal fistula developed, which required



FIG. 1.—Case I, after injection of pouch with argyrol.

another operation before it was finally closed. The patient was readmitted to the hospital a short time after, on account of the marked pyuria, which had not been influenced by the ureterectomy. It was decided at the time, that the stump of the ureter left behind was the source of the trouble, and an attempt was made to extirpate the remaining portion of the ureter. The sacral route was used, part of the coccyx resected, and after considerable difficulty, what was thought to be the ureteral stump, was excised. Microscopic examination proved this to be a diseased seminal vesicle. Since the last operation, eight years ago, he has at different intervals complained of diurnal and nocturnal frequency, severe burning at

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beginning and end of urination. The urine has been very turbid, and has contained large clumps of white material. He complains of pain in both loins, aggravated on defecation.

Physical Examination.—May, 1921, shows a man in good general condition. In the left hypochondrium there is a hard, firm mass, tender on deep pressure, and which moves with respiration. On rectal examination, the prostate is found moderately enlarged. On the right pelvic wall there is a hard mass, the size of an olive, not movable or tender. The urine is turbid. P. S. P. test 50 per cent. in two hours.

Cystoscopy.—The bladder is markedly inflamed, with areas of œdema and leukoplakia. At the site of the right ureter there is a firm polypoid œdematous



FIG. 2.—Case I showing coiling of catheter in pouch.

mucosa, and protruding from the orifice, a mass of purulent exudate. Corresponding to the site of the left ureter, there is an opening one-half cm. in diameter, with a circular, smooth edge, resembling the orifice of a large diverticulum. A ureteral catheter was introduced a distance of 14 cm. on this side, whereas, on the right side, a catheter was introduced 25 cm. Indigo carmine appeared in thirty-eight minutes after injection, from the left ureter, none from the right side. On irrigating the right ureter, thick, foul pus was washed out. A diagnosis was made of empyema of the right ureter stump, and it was thought that the left ureter was either enormously dilated, or emptied into a large diverticulum, in which the catheter coils up. A week or so later, the patient was recystoscoped with similar findings. An X-ray catheter was introduced into the right ureter, and argyrol injected. The radiograms distinctly showed a large pouch on the right side, this pouch being the dilated stump of the ureter. Within the pouch the catheter can be seen coiled up (Figs. 1 and 2).

Operation.—June, 1912 (Doctor Beer). A catheter was first introduced into the ureter stump. A right rectus incision, six inches long, was made, running

obliquely towards the median line. The fascia was incised, rectus pushed aside, and the perivesical fat was incised. Alongside of the bladder, and firmly adherent to the pelvic floor, the posterior abdominal wall and vas, and remains of the seminal vesicle on this side, there was found a hard mass, almost tumor-like in consistency and about five inches in circumference. Its length could not be ascertained, owing to the fact, that its upper limits could not be determined. This mass which was the dilated, infiltrated, diseased ureter stump, was so firmly embedded and bound down by adhesions, that it was impossible to free it. During manipulations, the peritoneal cavity was opened, and there was considerable venous oozing, so that the attempt to remove the ureter stump had to be abandoned and the wound packed, to control the bleeding. The patient recovered from this operation, but the purulent condition of the urine remained unchanged. Later on, attempts were made to incise the orifice with an electric cautery scissors, but on account of the fibrosis present, this could not be accomplished. The patient lived for about five years, and then succumbed from an infection of the other kidney.

There are a number of points of interest in this case. The surgeon who did the first ureterectomy was under the impression that he had excised the entire ureter, whereas, about two inches was left behind. In attempting to remove the stump of the ureter, the sacral route was chosen, resecting the coccyx. The operator was under the impression that the piece excised was the stump, in reality it was found to be a diseased seminal vesicle. Then a third attempt was made to excise the stump anteriorly, and it was found so firmly embedded, that a serious hemorrhage was encountered trying to free it, and the attempt at removal had to be abandoned.

CASE II.—N. B., male, age, twenty-nine, was admitted to Mt. Sinai Hospital, March 28, 1918, with the following history. His illness began a year and a half ago with frequent urination, nocturia, polyuria and pain in the back. Following an injection of salvarsan, six months ago, he developed anuria, with fever, chills and sweats. A diagnosis of right pyonephrosis was made, following which his right kidney was opened and drained. Since then, besides voiding naturally, he has passed large amounts of urine through the drainage tube, which is still *in situ*. He comes to the hospital on account of the urinary symptoms above noted, and to determine the cause of his persistent pyuria.

Physical examination shows a poorly nourished individual. On abdominal examination, both kidneys are distinctly enlarged. The urine is purulent. P. S. P. test 24 per cent. in two hours. Blood chemistry shows moderate retention of urea and nitrogen; X-rays of urinary tract, negative.

Cystoscopic examination demonstrates a moderate cystitis. No urine was obtained from the right kidney; which drains through the nephrotomy tube. Turbid, foul smelling, purulent urine was obtained from the left kidney. Indigo carmine did not appear within an hour after injection, from this side. A diagnosis of left pyonephrosis was made, and at operation an atrophic, pyonephrotic kidney, with very little parenchyma, was found. In view of the diseased kidney on the other side, it was deemed inadvisable to do a nephrectomy, and accordingly, the kidney was drained. The patient improved after this operation, and left the hospital with drainage tubes in both kidneys.

The patient was readmitted, January 15, 1919, on account of painful, frequent urination, and pyuria. Cystoscopy showed an inflamed bladder. The left ureter was obstructed at 2 cm., and no urine was obtained; the right ureter was unobstructed, and cloudy urine was withdrawn. Capacity of right pelvis, 60 c.c. Wassermann negative. Palliative treatment was instituted and the patient was

referred to the out-patient clinic. He was again readmitted for the same urinary symptoms, six months later. At this time it was noted that some of the voided specimens of urine contained a thick creamy pus which was found to come from the left kidney. The left kidney was extirpated; it was found totally destroyed, the ureter considerably thickened and dilated, and adherent to surrounding tissues. Following this operation the character of the urine remained unchanged. The final discharge note reads as follows. From time to time the patient passes from six to eight ounces of thick, creamy, foul smelling pus. On catheterizing his ureters, it was found that this pus came from the dilated left ureter, which was obstructed at 2 cm. The patient was readmitted in August, 1919, complaining of passing thick, foul smelling pus a number of times during the day. It was determined again by cystoscopy, that the source of this thick pus was the left ureter. Accordingly, on August 14th the left ureter was excised through a para-rectus incision. A very thick dilated ureter, filled with green pus, was found and excised down to what was thought to be its lower end. The operation was very difficult technically, on account of the dense adhesions surrounding the ureter. Microscopic examination showed a thick, necrotic ureter, with infection of all its coats.

The patient again returned to the hospital a year ago, August, 1920, complaining of difficulty in voiding, with passage from time to time, of six to eight ounces of foul smelling pus as before the previous operation (ureterectomy). His condition at this time was rather poor. The urine draining through the right nephrotomy wound was somewhat cloudy, with 25 per cent. P. S. P. in two hours. The voided urine, containing thick, foul smelling pus, had but 6 per cent. P. S. P. Cystoscopy showed an inflamed trabeculated bladder. The right ureter orifice was normal. Slightly cloudy urine was obtained from this side. The left ureter orifice was considerably contracted, and was catheterized for a distance of 6 cm. No pus was observed coming from the orifice before the introduction of the catheter. On removing the catheter, a stream of thick pus was seen to escape from the ureter stump. This procedure was repeated a few times with similar findings, long, tape-like masses of pus being passed. It was definitely determined that the source of the pyuria was the left ureter stump, which was approximately 6 cm. long. On account of the patient's poor condition, operation was not deemed advisable.

The patient was readmitted to the hospital four months later, February 11, 1921. As on the last two admissions, most of the urine was drained through his nephrotomy tube, a few times a day he would void about four to six ounces of thick pus. Cystoscopy showed findings similar to those obtained at previous examinations, that on withdrawing the catheter from the left ureter stump, there was a gush of thick pus. Post-urethroscopy demonstrated a picture similar to that found in contracture of the neck of the bladder, namely, supramontane swelling with thickening of inferior lid of sphincter. The residual urine varied between one and three ounces. The case was considered one of contracture of the neck of the bladder, with secondary infection and destruction of the kidneys. It was not considered advisable to attempt removal of the stump, as it would most likely be a formidable procedure on account of the dense adhesions, due to previous operations. In view of the fact that the right kidney is a pyonephrotic organ, its drainage was continued so as to control the infection with renal lavages. The patient was readmitted to Mt. Sinai a few weeks ago, February, 1923, for further study. His general condition now is very poor, he looks emaciated, and is markedly anemic. About fifteen to twenty ounces of turbid urine are voided daily, while about forty to fifty ounces drain through the nephrotomy tube. Blood chemistry shows moderate retention; the phthalein test of the combined voided and drained urine equals 40 per cent. for six hours.

Cystoscopic examination demonstrated a considerably inflamed bladder. The right meatus is normal, the left cannot be seen. On introducing a finger into the rectum and stripping along the course of the ureter, there was noted a thick, tape-like pus issuing from what was evidently the ureteral orifice. With this as a guide, a catheter was inserted a distance of 5 cm. The introduction of the catheter evidently loosened up a good deal of pus, which poured out of

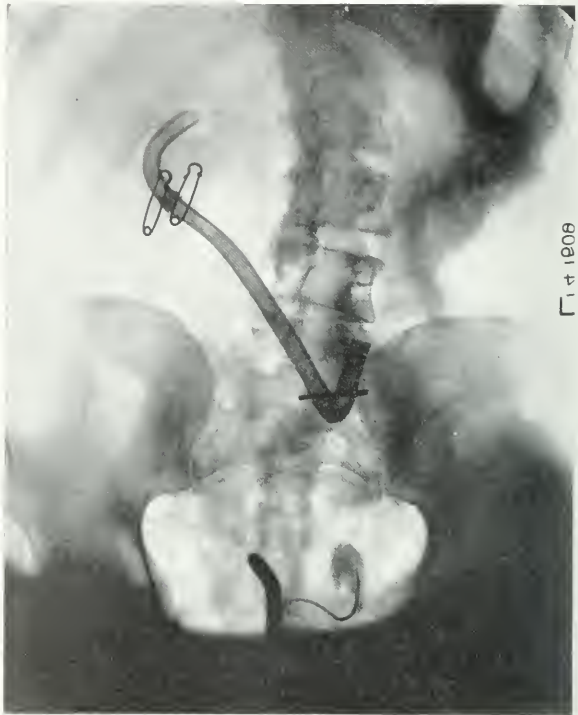


FIG. 3.—Case II, showing dilated ureter stump.

the orifice on withdrawing the catheter. An ureterogram was then taken, showing very distinctly the dilated ureter stump (Fig. 3). On account of his poor general condition, it is not considered advisable to attempt removal of the stump.

CASE III.—J. P., age twenty-six years, single, was admitted to Mt. Sinai Hospital (service of Doctor Beer), November 12, 1922, complaining of burning urination, pyuria, passage of fine calculi in the urine, and a persistent sinus in an abdominal scar. The patient gave a history of having been operated fifteen years ago, in Russia, for a right ureteral calculus. Five months ago he was operated upon in another hospital for a right pyonephrosis, due to an impacted

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ureter calculus. The kidney was found to be entirely destroyed. The ureter which was found considerably dilated was brought up to the skin and sutured in place, a large tube being passed down its lumen. Following this operation, the local condition did not improve, the pyuria persisted, and a sinus which formed at the site of the ureteral attachment to the skin, kept on discharging pus.

The patient was reoperated at the same hospital, about five weeks later, the ureter being excised down to the iliac vessels. It was impossible to remove the



FIG. 4.—Case III, showing longitudinal shadows in lower portion of right ureter.

remaining portion, owing to the dense adhesions and the patient's poor condition. The shadow in the ureter which was thought to be a calculus was found to be inspissated sand.

Following this operation there was no improvement in the condition of the urine which continued to be very purulent. The patient now complains of burning pain on urination, with the passage of granular material in the urine. He also has pain in the right side of the abdomen, along the course of the ureter, and a discharging sinus in the anterior ureteral wound.

Physical examination shows a rather poorly developed individual. There

is a right lumbar scar, also an anterior ureteral scar, in the lower end of which there is a small discharging sinus. A large exudate can be palpated in this region. Urine is purulent. P. S. P. test 20 per cent. Blood chemistry, normal. Radiograms show irregular longitudinal shadows in the region of lower portion of the right ureter (Fig. 4), which were interpreted as calcification within the ureteral stump.

Cystoscopy (Dr. A. Hyman).—Bladder considerably inflamed, with muco-



FIG. 5.—Case III. Demonstration by use of opaque catheter. The shadows noted in Fig. 4 are within the ureter lumen.

pus adherent to base. The right ureteral orifice is so markedly swollen and oedematous, that its opening cannot be seen. Thick, tape-like pus is seen issuing from the centre of this area of oedema. An opaque catheter was passed after considerable difficulty for a distance of 7 cm.: the radiograms taken with an opaque catheter *in situ* demonstrated the shadows previously mentioned to be within the ureter lumen (Fig. 5). Clear urine with good function was obtained from the left kidney. A diagnosis was made of suppurative calcified ureter stump and the persistent pyuria was attributed to this condition.

EMPYEMA OF THE URETERAL STUMP

Operation.—October 18, 1922 (Doctor Beer). Median suprapubic incision, bladder mobilized completely, and ureter exposed. It was found to be enormously thickened, a full one and one-half inches in diameter, and firmly adherent to the floor of the pelvis. The lower end of the ureter was first dissected free and followed up as far as possible, and liberated for a distance of two and one-half inches. The uppermost end, about one-half to three-quarters inch long, was too firmly embedded to allow of safe dissection. The mobilized part with the adjacent bladder wall, including the orifice, was excised. The anterior and lateral walls of the upper end which could not be freed were resected and the lumen was thoroughly curetted to destroy the mucosa and then carbolized. The ureter was found to be distended with pus and a large amount of soft calcified material. Suprapubic drainage was then instituted and an iodoform gauze drain introduced into the small pocket which represents the upper end of ureteral stump denuded of mucosa.

The patient made a rather uneventful convalescence, the only complication being a pelvic exudate, which developed a few weeks later, this cleared up entirely under hot rectal irrigations. The exudate in the region of the scar disappeared soon after operation. When discharged from the hospital, three weeks later, the urine was perfectly clear, the abdominal sinus had ceased discharging, and the wound was firmly healed. A small stone was spontaneously voided a short time after operation, this had no doubt been expressed from the ureter into the bladder, during the operation. The pathological report of the ureter showed fibro-muscular tissue, with many foci of infiltration.

These three cases conclusively demonstrate that the ureteral stump left behind after an incomplete ureterectomy may be the cause of a persistent pyuria. Two of the cases operated upon also revealed how difficult a surgical procedure it is to excise this stump, and emphasizes the necessity, when doing a primary ureterectomy for pyo-ureter, to excise the entire ureter down to its entrance into the bladder.

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RUPTURE OF TENDON OF EXTENSOR LONGUS POLLICIS FOLLOWING A COLLES FRACTURE*

BY ASTLEY P. C. ASHHURST, M.D.
OF PHILADELPHIA, PA.

UNDER the title of "peri-arthritis" used originally by Duplay and other French surgeons, it is convenient to group a number of lesions, of which one is the so-called spontaneous rupture of tendons. This occurs most frequently, perhaps, at the shoulder joint; the long tendon of the biceps, as pointed out by Gwilym G. Davis,¹ may give way under comparatively slight strain because already diseased or bound down by adhesions in the bicipital groove. Davis quotes from Robert Adams,² a description of the diseased state of the tendons about the joints usually found in this disease. The first case of subcutaneous rupture of one of the wrist tendons, appears to have been reported by Duplay,³ whose patient, a woman thirty-six years of age, and a cane-maker, suffered a rupture of the extensor longus pollicis tendon in a fall. Duplay sutured (by one metallic suture, later removed) the peripheral end of the long thumb extensor to a buttonhole made in the "premier radial externe" (extensor carpi radialis longior), because of the impossibility of end-to-end union, the ruptured ends being separated by a distance of 6 cm. Excellent function was secured within a couple of months in spite of the rather free suppuration which preceded final healing of the wound.

This case of Duplay's, however, was clearly traumatic, and there is no reason to believe the tendon was predisposed to rupture from intrinsic disease or from any form of peri-arthritis at the wrist. As such a complication of preceding disease, it seems to have been recorded first by German military surgeons, who, according to Steudel, have recognized, since the early eighties of the nineteenth century, an affection called "Trommlerlähmung" or Drummer's Paralysis. It results from chronic tenosynovitis produced by the peculiar method of holding and using the left drumstick. The rupture is said to occur usually during a paroxysm of drumming, or more rarely quite spontaneously. It is said to occur usually in beginners and to affect the left hand rather than the right. The subject was carefully reviewed in 1891 by Von Zander,⁴ who concluded it was an incurable condition; the drummers so affected in almost all cases had to be discharged from the army. He reported nineteen cases where the extensor longus pollicis was affected, and two in which the flexor longus was ruptured. A more recent study of the subject is that by J. Ramsay Hunt,⁵ in whose own patient, a tailor, who did heavy sewing and ironing for long periods, the rupture occurred almost spontaneously, while he was feeling around in his pocket for some articles. Hunt says his case is the only one in American literature; but he has overlooked the report of

* Read before the Philadelphia Academy of Surgery, January 8, 1923.

Scudder and Paul,⁶ whose patient sustained an apparently spontaneous rupture of this tendon some weeks after a fall on the hand which had caused only temporary disability. They operated by a modification of Duplay's method: finding it impossible to secure end-to-end union, the tendon of the extensor carpi radialis longior was split and one-half of it united to the peripheral end of the thumb tendon. A useful thumb, but not full power of extending the distal phalanx, was present eight months after operation.

Rupture of the extensor longus tendons to the fingers has occurred also; in Melchior's⁷ patient it was attributed to gonococcic tendovaginitis.

Among the less usual causes for rupture of the long extensor of the thumb, is a Colles fracture. It is strange, indeed, that this lesion is not a more frequent sequel of fractures around the wrist, since the tendons on the dorsum, especially that of the long extensor of the thumb, lie in very deep grooves against the bone, and it seems that they should very easily be caught by adhesions, under which circumstances a so-called spontaneous rupture might easily occur.

CASE REPORT

On March 20, 1922, Lt. Comm. John T. Bennett, U. S. N., brought to consult me his colleague, Dr. C. S. N., thirty-one years of age, with the following history: On January 24, 1922, Dr. N. had fallen on his over-extended left wrist, breaking the radius close to the joint; there was scarcely any displacement shown by the X-ray, and a splint was worn only as a matter of form, for a period of two weeks. He then gradually resumed his surgical work. About the first of March, after being engaged in an especially difficult operation, in which considerable retraction of the wound edges was required; and after having been occupied rather long hours in anatomical dissections; he noticed some pain for a few days in the radial region of the left wrist. Later the pain became very severe. It seemed as if there was tenosynovitis on the dorsum of the wrist, but no crackling could be detected. He wore a splint again for a while.

Examination showed complete loss of function in the extensor longus pollicis, as evidenced by inability to extend the distal phalanx on the proximal or to make the tendon contract visibly in its normal course below the wrist. The extensor brevis and all other tendons acted normally. The patient told me he had tested the forearm muscles with the faradic current, and that no contraction of the long extensor could be secured, though all other muscles reacted.⁸ He also called my attention to the statement in DaCosta's Surgery¹⁰ that rupture of the long thumb extensor "sometimes occurs, apparently spontaneously, a number of weeks after the occurrence of Colles fracture."

The diagnosis and the cause of the lesion being recognized, operative repair of the tendon seemed indicated. Certainly end-to-end suture of the tendon was

⁸Hunt went to quite unnecessary lengths, it seems to me, to prove the condition was not due to a nerve lesion, but caused by an actual rupture of the tendon. He claims that the extensor longus pollicis and the extensor indicis are jointly innervated by a single small branch of the posterior interosseous, and that neural paralysis of one muscle without that of the other is unknown. But in Cunningham's Anatomy⁹ is an illustration of these nerves showing the branch to the extensor indicis arising from the main trunk of the dorsal interosseous much nearer the elbow than the branch to the extensor longus pollicis, which arises entirely independently from the main trunk some distance lower down. These facts I have verified on the cadaver.

to be preferred; but in case this should prove impossible, it was determined to fasten the peripheral end of the ruptured tendon to some other tendon in the neighborhood, either one of the other thumb extensors, as advised by Hunt, or one of the radial extensors of the carpus.

Operation was undertaken at the Orthopaedic Hospital, on March 25, 1922. Under local anesthesia (one-quarter per cent. novocain) an incision 10 cm. long was made over the course of the tendon from below the annular ligament up over the forearm. The peripheral end of the tendon was easily found, just below the annular ligament, and very loosely attached. The proximal end was difficult to identify but was finally found on the radial side of the extensor indicis just above the annular ligament. It was densely adherent to callus in its radial groove, and above this point was quite frayed out. The distal end had ruptured transversely just below the adherent point; evidently the flexor tendons, during strong grasping movements, had pulled the distal end of the tendon free from its anchorage, while the contractions of the extensor longus pollicis itself had not been able to pull the proximal end loose. The ends of the tendon were united, end-on, by three chromic catgut sutures No. 0; the annular ligament covering the tendons of the extensor communis digitorum was repaired over them where opened in the search for the adherent proximal end of the ruptured tendon; but the tendon of the extensor longus pollicis was not replaced in its groove next the bone, nor was any attempt made to remove the scar tissue in this deep groove, as it was thought any such attempt would lead to more dense adhesions. The deep fascia, however, was carefully sutured over the reuniting tendon so as to prevent it from riding away from the bone, like a bow-string. Finally the superficial fascia and the skin were each closed separately with No. 00 chromic catgut. A moulded gypsum splint was applied to the flexor surface of the hand and forearm, keeping the latter in full supination, with the fingers and thumb in hyperextension, and the wrist in abduction.

The first dressing was made April 15, 1922, three weeks after operation: the wound was healed and the skin sutures absorbed. The patient was able to flex and to extend gently the terminal phalanx of the thumb. The gypsum splint was shortened to allow the four fingers free motion below the metacarpal joints, but keeping the thumb still in hyperextension. I advised that after five weeks from operation a splint to support the thumb should be worn, at night only, for three or four weeks longer, when I thought active use of the thumb should be encouraged. Under date of October 29, 1922, the patient wrote: "the function of my left thumb has entirely returned. I kept the thumb splinted until the middle of June. It was very stiff and painful for another month but since then I have been going about my usual operative work and now notice no disability."

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held March 5, 1923

The President, DR. JOHN H. JOFSON, in the Chair

ACUTE INTESTINAL OBSTRUCTION DUE TO IMPACTED ASCARIDES LUMBRICOIDES

DR. JAMES A. KELLY presented a girl ten years of age, who was admitted to St. Mary's Hospital, November 6, 1922, with primary diagnosis of appendicitis (acute) and diffuse peritonitis. On admission temperature was 100, pulse 120, and respirations 136. She had been indisposed for about two weeks, complaining of nausea, anorexia and constipation. These symptoms increased, until the day before admission, when the patient was unable to have a bowel movement, became very restless and abdomen became rigid, tender and distended. Physical examination on admission showed a moderate degree of abdominal distention with generalized tenderness, particularly marked over right lower quadrant of abdomen. Patient vomited after admission, vomitus consisting of dirty, grayish-black material, and fetid, which was not fecal in character. Under ether anæsthesia examination of abdomen showed considerable relaxation and the presence of several masses, suggesting a diagnosis of acute intestinal obstruction, acute appendicitis or tuberculous peritonitis. Examination of urine negative. Blood examination showed red blood cells 4,100,000, white blood cells 11,400 and hæmoglobin 90 per cent. Differential blood count polymorphonuclear leucocytes 80 per cent., large and small lymphocytes 20 per cent. No eosinophiles.

Operation.—Through a four-inch median line incision below umbilicus the abdominal cavity was opened and about six ounces of clear peritoneal fluid was found. Exploration showed two portions of the small intestines completely filled with irregular masses extending in one portion for a distance of eight inches and in another portion for a distance of twelve inches. Through two enterostomy openings the masses were removed and found to be closely packed groups of ascarides lumbricoides. The enterostomy openings were closed, a cigarette drain was placed in the pelvis and the abdomen closed by layered sutures. Patient made an uninterrupted surgical convalescence, and was later referred to medical service for the treatment of intestinal worms. The number of ascarides lumbricoides removed was one hundred and fifty-four. Examination of the fæces showed innumerable eggs of the above-mentioned parasite. Patient was discharged six weeks after entrance and at present date, March 1, 1923, has had no further trouble, although eggs are still present in fæces.

INCISED WOUND OF THE FOURTH AND FIFTH CERVICAL NERVES

DOCTOR KELLY presented a man, thirty-eight years of age, who was admitted to St. Mary's Hospital, June 27, 1922. This man on June 1, 1922, while doing some repair work at home, was standing on a table holding a putty knife. The leg of the table broke, throwing him to the ground, the putty knife piercing his neck. In the emergency room he was given a careful examination, laceration over right sterno-mastoid muscle being the only injury. Five sutures were inserted. When seen in his room he complained that his arm was numb from the shoulder (right) down, only motion he was capable of was at the wrist. Further examination showed palsy of right arm and forearm, slight numbness of right thumb. Inability to raise right arm or forearm. Flexes and extends finger and wrist. No wrist drop. Has power of partial pronation and supination. Grip in right hand good.

Motor Phenomena.—All motor power except flexion and extension of fingers and wrist and partial pronation and supination of arm and forearm lost. Cannot raise arm or forearm from bed.

Sensation.—All sensation, both superficial and deep in fingers, hand, forearm, and lower one-third of arm O. K. Almost complete anaesthesia over deltoid and lower portion of trapezius muscles, certainly superficial sensation completely lost. (Fig. 1.) Deep sensation impaired below deltoid to about middle of third of arm. There is undoubtedly a lesion in the cervical plexus, probably a partial severance of the fourth and fifth cervical nerves, affecting the spinal branch of the spinal accessory nerve, which supplies the circumflex which also begins at the fifth cervical nerve and supplies the deltoid.

Diagnosis.—Lesion of the cervical plexus, probably affecting the fourth and fifth cervical nerves and in all probability a severed nerve or partially so, rather than a hemorrhage, since the patient had a complete loss of function from the time of injury.

Operation.—Temporary sutures removed from wound of neck. It was then found that the skin incision was continuous with and parallel to the fibres of the sterno-mastoid muscle, just outside of the carotid sheath. This wound was enlarged through the sterno-mastoid muscle and after considerable difficulty and deep retraction there was found a complete severance of the right fourth and fifth cervical nerves. (Fig. 2.) This wound was so close to the vertebra that the periosteum from the right lateral process of the fourth cervical vertebra was chipped off. The cut ends of both nerves were approximated by two interrupted sutures of fine silk and the wound closed without drainage. Patient made an uninterrupted convalescence, and was in the hospital twenty-six days.

Condition six months later; examination by Dr. M. A. Burns, December 29, 1922.

Motor Phenomena.—Patient has a partial palsy of upper right extremity. Grip good, unable to abduct arm very well, seems to annoy him at shoulder joint. Able to adduct very well and seems to have considerable power performing this movement; unable to flex forearm

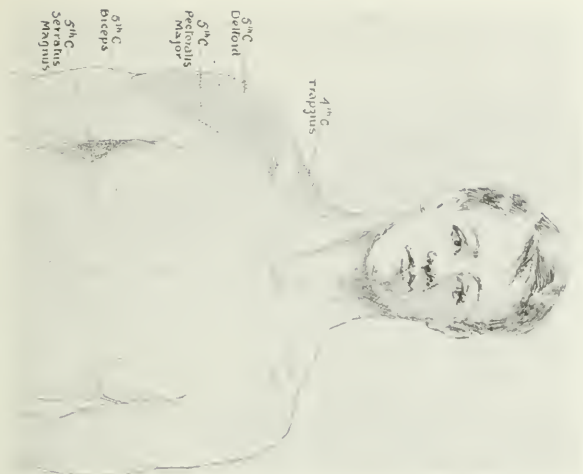


Fig. 1. Showing area of distribution of muscular paralysis and of sensation.



Fig. 2. Case II, shows retraction of primary wound of skin, fat and sternomastoid muscle, exposing the severed ends of the fourth and fifth cervical nerves. Insert shows method of repair.

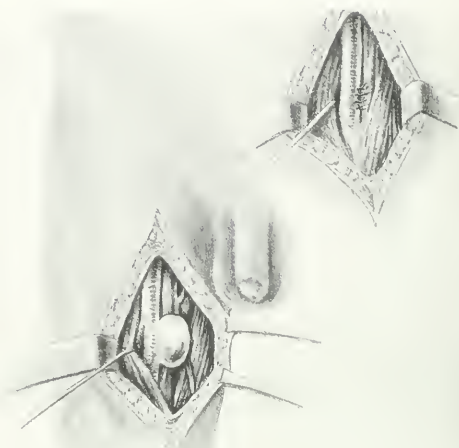


FIG. 3.—Case III, shows formation of traumatic aneurism. The sac was readily removed from the artery and the wound of artery closed by four interrupted sutures, as shown in insert.

without aid of other hand, but after he gets forearm up, he can use hand very well. There is no evidence of wrist drop. The forearm is unusually well developed, but his arm shows evidence of considerable atrophy, especially over the deltoid and trapezius muscles. Patient still unable to raise arm of itself, but has considerable power in it after he flexes it with the aid of the other hand.

Sensation.—Sensation is normal over deltoid, and almost normal over the trapezius muscles, except there is some slight diminution in sensation just around the insertion of the deltoid. There is a very marked degree of sensation returned and perfectly normal over deltoid and trapezius, and also a marked increase in motor power, although there is some palsy still remaining.

Electrical Reactions.—It is impossible to take the electrical reactions at this time.

March 1, 1923.—Muscular power slowly increasing. Muscular atrophy disappearing. Patient has been able to drive his automobile for the past two months.

BULLET WOUND OF THE THIGH PRODUCING TRAUMATIC ANEURISM OF FEMORAL ARTERY

DOCTOR KELLY presented a man, twenty-three years of age, who was admitted to St. Mary's Hospital, October 31, 1922, suffering with bullet wound of the right thigh, accidentally received.

Examination on admission showed a bullet wound of the right thigh with wound of entrance on surface of thigh about the middle and in the line of the femoral vessels. Wound of exit on posterior surface of thigh level as wound of entrance. Considerable bleeding had taken place, but the patient was not in condition of extreme shock on admission. Wound of entrance and exit thoroughly cauterized and dry, sterile compression dressing applied and a prophylactic dose of anti-tetanic serum administered in the receiving ward. Blood examination on admission showed red blood cells 4,150,000, white blood cells 10,600 and hæmoglobin 80 per cent. As there was present pulsation over the popliteal artery after admission, it was considered probable that the femoral artery was not injured. The patient was carefully watched and after the sixth day there began to take place an evening rise in temperature, accompanied by a localized swelling around the wound of entrance.

Operation.—Ten days after admission, under gas anæsthesia, an incision was made through the wound of entrance, with the idea of probably evacuating a localized collection of pus. There was a considerable spurt of bright red blood. The wound was hurriedly packed with gauze and a tourniquet applied high up on the thigh. The gauze was then removed, the wound enlarged and the femoral vessels exposed. Surrounding the site of the femoral artery there was an organized blood-clot in the form of a saccular aneurism. This was carefully removed and it was then found there was a wound of the inner portion of the femoral artery, with a loss of about one-quarter of its calibre (Fig. 3). Four interrupted lateral sutures of fine silk were then used

to close the wound of the femoral artery and a small rubber tissue drain introduced to the site of the suture. Upon removing the tourniquet pulsation was then noticed in the femoral artery below the line of suture and there was no leakage from the line of suture. The wound was then closed in layers except at the point of rubber tissue drainage. The drain was removed on the fourth day and the patient made an uninterrupted convalescence. At no time during the convalescence was there noticed any evidence of obstruction at the line of suture. Examination on March 1, 1923, shows wound entirely healed and the only symptom the patient complains of is a slight referred pain down the thigh to the knee.

DR. ASTLEY P. C. ASHURST said that about a year ago, in reporting to this Academy a somewhat similar case, Doctor Muller brought up the question as to whether or not in civil life it was proper to explore such wounds without waiting for the further development of symptoms. Doctor Muller said that all authorities taught that one should not operate unless there was active hemorrhage at the time. This is of course according to the traditional rule; and it does not appear that either Doctor Muller's patient or Doctor Kelly's patient suffered any harm as a result of delay in the operation. They did right in delaying it, because there was no proof that any large vessel was injured. The presence of pulsation below at the time of injury is in accordance with what was seen during the war, when with no bleeding from the wound and continued pulsation in the peripheral branches, exploration sometimes revealed injury to the vessel; the French surgeons well described these cases as "*lésions sèches*" of the arteries.

At the time of injury a distinction is to be made between (a) lesions *sèches*; (b) pulsating hæmatomas (or diffuse traumatic aneurisms); and at a later stage, (c) traumatic aneurism (circumscribed). In military surgery wounds which may involve large blood-vessels are explored as soon after injury as possible, because *débridement* is required to prevent infection, and because the patients must be transported and cannot remain constantly under surgical care. In civil life infection is little to be feared, and the patients do not have to be transported. In both civil and military surgery, however, the presence of a pulsating hæmatoma demands early operation. But a circumscribed traumatic aneurism should be left alone. Even where it is possible to do a Matas operation, it is desirable to leave it alone for several months, at the end of which time the walls lining the cavity will be in a condition where the operation can be done with comparative safety. If one does it too soon after the injury, there is nothing to hold the sutures. Whether the return of pulsation in the peripheral arteries that has taken place in Doctor Kelly's case is due to collateral circulation or to persistence of the lumen of the femoral artery, it is of course impossible to tell.

DR. D. L. DESPARD said that he had a case of a man who was shot, the bullet passing between the artery and vein, cutting both. He immediately had tremendous swelling and cutting off of the circulation below. Operation seemed to be at once imperative; the wound in the artery was found and

GUNSHOT FRACTURE OF THE FEMUR

closed; the vein he had to tie; pulse returned and was present for a larger part of the next day. It was very faint, however, and the evening of the second day after operation it could not be felt at all. It returned in three or four days, evidently reestablished through collateral circulation. The man had complete recovery of circulation in the leg.

DR. HUBLEY R. OWEN showed again a case which he reported to the Academy some time ago of gunshot wound of the popliteal artery. At the time he reported it as a popliteal aneurism.

Since then he had operated on the man and found no aneurism but an aneurismal varix. There was a small opening between the artery and the vein, so small that he did not have to suture. He put in ligatures and the man made a good recovery. He had some swelling of the lower leg and had to wear a canvas stocking. Two or three weeks later he did a second operation and made a search for the small piece of bullet, but it could not be found. His Wassermann was negative.

GUNSHOT FRACTURE OF THE FEMUR AND WOUNDS OF THE FEMORAL VESSELS REQUIRING AMPUTATION

DR. DAMON B. PFEIFFER presented a negro man, aged twenty-nine, who was admitted to the Presbyterian Hospital at 10.30 P.M., December 25, 1922, on the service of Dr. John H. Jopson. About an hour previously he had been shot with a .38 calibre automatic pistol loaded with steel-jacketed bullets. He was hit twice, the first bullet causing a tangential wound of the anterior abdominal wall. The wound of entrance was in the right rectus just below the costal margin and the wound of exit over the left rectus at a point symmetrically situated. A transverse ridge, indicating the course of the bullet could be seen and felt between the two except where the tract had passed through the muscles. Examination showed no abnormality of the abdomen; he was not shocked; he presented no sign of loss of blood. Temperature was 99; pulse, 80; and respirations, 20 per minute. He complained of some dull pain in the right thigh, but on the whole was fairly comfortable and in good condition. The right thigh was enormously swollen throughout and the tissues were tense and hard. The thigh was warm but below the knee the leg was cold and no pulsation could be detected in the anterior or posterior tibial arteries. Sensation in the leg was present but diminished. There was a bullet wound of entrance on the outer aspect of the thigh at the junction of the middle and lower third. At this point the thigh was fractured. It was evident that a wound of large vessels was present and the situation made it probable that the femoral vessels were concerned. No thrill or bruit was present.

DOCTOR PFEIFFER, realizing that the condition probably called for amputation, decided, however, on account of the excellent condition of the patient, to determine whether a reconstructive operation could be done. He accordingly debrided the wound of entrance down to the site of fracture. As soon as the fascia lata was incised the muscle herniated through the wound under great internal pressure. The femur was extensively comminuted. The tissues in immediate relation were pulpi-

fied, and a large cavity was present filled with blood-clot, detached splinters of bone, and surrounded by infiltrated connective tissue and muscle. At the upper limit of this cavity the femoral artery could be felt pulsating. Below this point no pulsation could be detected. Release of tension and disturbance of the cavity resulted in active hemorrhage. The tourniquet which had been placed about the thigh was therefore tightened and an incision made on the inner aspect of the thigh to afford better access to the vessels. So great was the infiltration of the tissues that difficulty was experienced in locating the vessels and it was noted at about this time that the patient was showing signs of shock which made it doubtful whether he could endure any unnecessary prolongation in the operation. He therefore decided to amputate without delay. The lead core of the bullet was found in the large cavity and the steel jacket which had become detached lay beneath the skin on the inner side of the leg.

After an intravenous infusion of salt solution the man rallied well and made an uncomplicated recovery, excepting for a slight stitch infection of the uppermost sutures, which fortunately did not become communicated to the field of amputation. The vessels were later dissected and it was found that both the femoral artery and vein had been almost completely divided, being held together by only a narrow bridge of the posterior portion of the vessel walls. In addition there was a punctured wound of the femoral artery about one inch distal to the large wound. The reporter remarked that although vascular surgery has now reached the point where it is indicated to consider repair rather than ligation or amputation as primary procedures, this case violated all the conservative rules laid down by Makins for the performance of suture. There was no reasonable probability of maintaining the wound in an aseptic condition. The wounds of the vessels were multiple and extensive. Circular suture would have been required and immobilization in a position to secure freedom from tension was impossible because of the fracture.

Concerning the necessity for amputation it should be realized that ligation of the femoral vessels at the point of origin of the anastomotic magna would be likely under any circumstances to be followed by gangrene or such damage to the leg that its usefulness would be abolished. The added danger introduced by the comminuted fracture made the risk to life prohibitive. Preliminary exploration, however, was indicated by the fact that wounds of the branches of the femoral artery may at times cause a hæmatoma of great dimensions simulating a wound of the parent vessel. In such a case simple ligation would probably save the leg.

REPAIR OF THE MUSCULO-SPIRAL NERVE

DR. D. L. DESPARD presented a boy, aged thirteen years, who was admitted to Abington Memorial Hospital, May 11, 1919, having been injured by receiving a load from a gun at 12 or 15 feet distant. The outer and posterior part of the triceps was carried away and with it the musculo-spiral nerve for about four inches. The skin wound was so extensive that efforts toward primary repair of the nerve were not wise.

On October 15, five months after the injury, the wound having completely healed, the ends of the nerve were exposed, and by stretching, the gap of four inches was reduced to two inches, the bulbous ends were freshened up and both ends sectioned half through about an inch and one-third from their extremities and split longitudinally to within a third of the ends, the flaps thus formed were approximated, bridging the gap. The exposed nerve was then snugly surrounded by a cuff of fascia lata from the thigh. The wound healed by first intention, and in about two months there was some evidence of the reestablishment of function.

The progress was very slow for a while, and he lost sight of the patient until June of 1921, when he then saw him his recovery was very satisfactory.

His reason for reporting this case is that this method has not been of late years generally popular, and to show that in some cases it is justifiable, especially in the very young, where nerves available for bridging the gap are so small as not to be suitable.

DR. DE WITT STETTEN (of New York) commented on the result obtained in this patient with musculo-spiral paralysis. He was especially interested in this case because he had done the same operation once himself and because the method is one that is universally condemned by neurological surgeons to-day. Eleven years ago he saw a case of complete musculo-spiral paralysis secondary to an operation for osteomyelitis of the humerus. The nerve had evidently been severely damaged during the bone operation because he found a dense scar in the nerve which he resected, leaving a defect of about an inch and a half. He then did exactly the same operation that Doctor Despard had performed, turning down the flaps from either end of the resected nerve to bridge the gap. A few days after the operation, in glancing through Sherren's book, "Injuries of Nerves and Their Treatment," he was much shocked to find that this method was described as one only to be condemned and that the results were as unfavorable as the method would lead us to expect. The author referred to other methods to be used in such cases and laid particular stress on the auto-transplantation of relatively silent sensory nerves—for example, the radial nerve from the forearm in musculo-spiral paralysis. He felt that he had made a very serious blunder and was more or less convinced of that fact after a year had passed without any return of function. But after fourteen to sixteen months, the patient began to show some restoration of muscular power in the extensors of the wrist and fingers and within the next four to six months he made a complete recovery. The method may be a bad one, but certainly it sometimes works rather well—even better than the recommended methods—as these cases have demonstrated.

DR. ASTLEY P. C. ASHURST said that at the first joint meeting of the Academy with the New York Surgical Society (ANNALS OF SURGERY, 1920, vol. lxxii, p. 408) he reported three cases of nerve suture, two of the patients having been treated in this way with flaps turned down from the ulnar or

median nerves, with perfect recovery. The neurologists say recovery is not possible by this method and that the patients get regeneration of the nerve in spite of the operation. Perhaps they might claim that the nerve impulses in Doctor Despard's patient do not come through the collateral circulation, as it may be called, which was established by the operation; but that the nerve fibres have eventually perforated the bulbous scar and have found their way to the distal end of the nerve along the channel established by the tube of fascia lata. But in his own two cases, where the neuroplasty was a primary operation, for recent injury, no fascial tubes of any kind were placed around the nerves.

SPLENECTOMY FOR ADVANCED SPLENIC ANÆMIA

DOCTOR DESPARD recited the history of a boy, aged thirteen years, who was admitted to Methodist Hospital, March 13, 1922, with an enlarged abdomen and swollen legs.

His general health had been good until 1914, when he developed acute mastoiditis and was operated upon for it. He was reoperated upon November the same year for a recurrence of the trouble.

In the spring of 1916, he had pneumonia; following this he developed acute appendicitis, was operated upon, an abscess drained, and the discharge continued for four months. During this time he was said to have had an abscess of the liver. The stools contain pus.

Present Illness.—About six months after the appendiceal wound had healed, he felt badly, and it was noticed that the abdomen was swollen and he had lost a good deal of weight.

In the summer of 1920, after eating raspberries, he had an attack of acute indigestion and vomited blood and the abdomen was swollen at this time.

In 1921, he had a similar attack, and while he did not vomit blood, he passed it in the stools. The abdomen was swollen at this time, but this soon disappeared.

In December of 1921, he fell while playing and hurt himself, was nauseated and passed dark tarry stools. He has been losing weight, looked anæmic and felt badly since then. For the past three weeks he had been in bed. The abdomen is gradually getting larger, but he had not had tarry stools since being in bed.

Physical examination showed a very emaciated looking boy, slight œdema under eyes. Head, ears, eyes and teeth normal. Tonsils are not enlarged. The lungs and heart are normal. The abdomen is greatly distended with fluid, which embarrasses the respirations. Scar of previous operation below the umbilicus and to the right. The extremities are slightly œdematous and the reflexes are normal.

Clinical Notes.—Abdominal paracentesis March 16, 1922, and six quarts of turbid straw-colored fluid removed.

March 14, 1922, blood examination: hæmoglobin 60 per cent., red blood cells 3,040,000, white blood cells 3000, polymorphonuclear cells 50 per cent., small lymphocytes 30 per cent., large 20 per cent. Stools were negative for blood.

SPLENECTOMY FOR ADVANCED SPLENIC ANÆMIA

Chemical Examination of Blood.—Sugar, 0.1000 per cent.; urea, 18 mg. per 100 c.c.; creatinin, .9 mg. per 100 c.c.; chlorids, 6.25 mg. NaCl per L.; uric acid, 1.5 mg. per 100 c.c. Wassermann negative.

Examination.—Ascitic fluid March 16, 1922, color pale yellow, turbid, no coagulation, albumin 1.9 per cent. After paracentesis the spleen was found to be enlarged and to extend 6 or 7 cm. below the costal border.

April 4 paracentesis again performed, yielding 196 fluid ounces, temperature is ranging between normal and 100 degrees.

Blood Examination.—April 4, 1922, hæmoglobin 55 per cent., red blood cells 2,800,000, white blood cells 2400, polymorphonuclears 60 per cent., small lymphocytes 28 per cent., large lymphocytes 8 per cent., monomorphonuclears 4 per cent., coagulation time 3 minutes.

April 6, 1922.—Splenectomy through a left rectus incision. The spleen was very large, extending to the crest of the ilium. The number of adhesions to diaphragm were few and easily broken up; the liver was enlarged and relatively smooth. A large amount of milky fluid was liberated on making the incision.

Before closing the wound an extensive epiplopepy was done. The patient was somewhat shocked from the operation and an immediate transfusion of 500 c.c. of blood by direct method was performed. The wound healed by first intention, but notwithstanding this the temperature range was from 100 to 103 degrees, gradually subsiding, but in the neighborhood of 100 at the time of discharge from the hospital.

The blood examination nine days after the operation on April 15, 1922, was hæmoglobin 68 per cent., red blood cells 3,200,000, white blood cells 11,000.

A guinea pig killed one month after inoculation with ascitic fluid showed no evidence of tuberculosis.

Continued favorable reports of his progress have been received and he has gained weight, is going to school and seems to be well.

The reporter remarked that the reason for presenting this case was to call attention to the fact that in very serious cases of splenic anæmia, operation may under certain conditions bring about apparent cures.

The function of the spleen may be grouped under three heads: (a) Destruction of worn or feeble red cells, white blood cells and platelets. (b) The production of lymphocytes. (c) Filtering toxic substances and bacteria from the blood.

Normally the blood supply is vastly more than required for its own needs. Under the stimulation of toxins, possibly not always bacterial, this function becomes perverted, as evidenced by the wholesale destruction of red blood cells, the leucopenia, and the resultant injury to the liver in the production of a portal cirrhosis.

It would not seem illogical to assume that detrimental substances other than those that are known, might have their origin in an organ that had departed so far from the normal.

The removal of the spleen does good by diverting toxins from the blood,

or possible toxins originating in the spleen from the liver, which if continued, result in fibrosis of that organ and ultimate destruction of the liver cells.

It is for these reasons that the best results are obtained in the removal of large spleens that are sending immense quantities of blood to the liver laden with poisons, and the operation must be relatively early before irreparable injury has been done to the liver. It must be borne in mind that the liver has powers of regeneration, and may in time recover from considerable injury.

Small spleens are not so charged with possibilities for damage, and their removal is not accompanied with such marked improvement, even in hæmolytic jaundice.

The specimen removed is a spleen markedly enlarged, moderately soft and dark in color. On sectioning there is noted a considerable thickening of the capsule with much fibrosis throughout the entire organ. The pulp is soft and wet and much blood exudes from the cut surface. Weight is 1460 gms.

Sections show spleen in which there is considerable dilatation of the sinuses which are filled with blood. There is a distinct increase in connective tissue throughout the section. Some sclerosis of the splenic vessels is found and the capsule shows a marked thickening. The trabeculae are also much increased in size. The gross and microscopic appearances of the spleen are consistent with those of an early Banti's disease.

TECHNIC OF INGUINAL HERNIOPLASTY

DR. DE WITT STETTEN, of New York, read a paper with the above title, for which see page 48.

DR. JOHN H. JOPSON said there are two or three fallacies in the general belief regarding hernia. A great many failures are due to the fact that the individual case has not been studied at the time of operation. The operation for hernia is a plastic one and there are varying conditions to be met just as in any other types of plastic operation. Failure is due to the fact that many surgeons simply go through the motions of the operation. He thought the Fergusson operation was a great step backwards in hernia work. Again, one can get muscle to adhere to fascia by suture, in spite of statements to the contrary. He knew that it will grow there because he recalled two cases where he operated for femoral hernia through the inguinal route, after an inguinal hernia operation had been performed, doing Ruggi's operation, and found the fibres of the internal oblique and transversalis so closely adherent to Poupart's ligament that one might have thought they had been implanted there originally instead of sutured by the surgeon.

DR. HUBLEY R. OWEN said that a couple of years ago he read a paper on hernioplasty before the State Medical Society; and, on looking up data for this paper, he found only two papers which gave statistics which were accurate. It was because these surgeons or some member of their staffs had personally examined the cases for recurrences.

Doctor Ashhurst in his surgery cited Coley's statistics and said recurrence occurred in very few cases. Blake quoted 25 per cent. recurrences. In the Mumford series of 97 there was one recurrence. Da Costa quoted Coley's figures. Rosenthal quoted 10 per cent. Masson, of the Mayo Clinic, out of 17,017 cases in a series, less than one per cent. recurrences. There are few statistics which differentiate the direct from the indirect, and statistics without this differentiation are of little value. Taylor of the John Hopkins reported a series of 230 cases for indirect with 46 recurrences or 5.6 per cent. and 256 indirect with 18.08 per cent. recurrences.

Bruner reports 21.4 per cent. recurrences and Moscovitz 6.86 recurrences. Earle operated on 38 cases with no recurrences.

Unless a man examined his own cases at regular intervals of six months to two years he can't give accurate statistics. Taylor reported that of his cases examined at the hospital, there was recurrence in 29.7 per cent. and of those heard from by letter 6.3 had recurrences.

The speaker had performed Doctor Stetten's operation on 28 cases. Among these he had had but one recurrence. This recurrence was in a patient fifty-one years of age, operated on for bilateral hernia. There was a recurrence on the left side before he left the hospital. He could not definitely claim, however, that the other 27 cases had been cured, because some of these cases were but recently operated upon. None of them have been operated upon for a length of time to consider the cure absolute.

There was an excellent article in a recent ANNALS OF SURGERY by Erdman, giving the statistics of hernia on Pool's service. The great value of these statistics was that every case was examined by Doctor Pool or by a member of his staff. Of Erdman's cases there were 604 oblique hernias with 3.15 per cent. recurrence and 313 direct hernias with 16.61 per cent. recurrence. There were 255 indirect hernias with 17 per cent. recurrence.

From his own experience he believed that Doctor Stetten's operation has been more satisfactory than any other operation for direct hernia. Doctor Stetten discussed the question of age in so far as recurrence is concerned, Doctor Taylor of Johns Hopkins reports that 50 per cent. of the hernias recur after forty years and 25 per cent. after fifty years of age. Doctor Stetten does not agree with Doctor Pool that the operation is inadvisable after fifty-five years of age. The speaker agrees with Doctor Pool, if he finds a patient of even fifty years of age can wear a truss and the truss holds his hernia satisfactorily, he advises him to wear a truss, providing that the wearing of a truss does not interfere with his work. If he elects to be operated upon, he operates upon him, but tells him frankly the statistics regarding recurrence. The oldest case of his series was a man seventy-one years of age with a bilateral hernia. His hernia on the right side was of the type which is claimed to have "lost the right of domicile." He was unable to purchase a satisfactory truss. He has had no recurrence as yet, but the operation was only performed six months ago. Statistics are of no value until two years after an operation for hernia.

He did not think that Doctor Stetten's operation to be necessary in all cases. We should be guided by the type of case. An indirect hernia, especially in a child, requires only the ordinary Fergusson operation. The Stetten operation is advisable for a direct hernia and one where the muscles are weak.

As to anæsthesia he had not been able to get good results with local anæsthesia. The Johns Hopkins statistics show a larger percentage of recurrences in cases done under novocaines than those under general anæsthesia. He uses nitrous oxide gas, often infiltrating the line of incision with a little gas, and when he cannot do that he gives spinal anæsthesia.

Concerning the time in bed, he tries to keep all his cases in bed for two weeks, and direct hernias for 21 days. In the police and fire departments the men are not allowed to assume duties of any kind until four weeks after discharge from the hospital after a hernia operation and no active duty until three months after discharge from hospital.

DR. ASTLEY P. C. ASHHURST said that he did not know what his own results were, but he believed the statement quoted in his text-book from Coley's statistics to be correct concerning recurrences, and that after a properly done Bassini operation, 95 per cent. of indirect hernias do not recur. In the other figures quoted just now by Doctor Owen, the recurrences were approximately five per cent. after the Bassini operation where special attention has been paid to high suture of the neck of the sac. In direct hernias every one knows there is a much greater proportion of recurrences. The conjoined tendon is never absent. It may be defective but it is never deficient: there is always some place where the lower fibres of the internal oblique and transversalis muscles are inserted, and that is the conjoined tendon.

DR. DE WITT STETTEN (in closing discussion on his paper): In regard to Doctor Owen's remarks he could not quite agree with him on the age question. A man fifty-five or even older, who is troubled by a hernia is as much entitled to relief as one of thirty-five. This is especially true when the operation is done under local anæsthesia and the risks of general anæsthesia are eliminated. Although it is a fact that the two recurrences he had observed were in men of fifty-five and fifty-six years of age, respectively, in general, his results certainly do not seem to indicate an unusual tendency to recurrence in older individuals. In his last series there are from twenty to thirty cases in men of fifty or over who seem cured, and he had made it a rule to examine these patients about once a month. This last group is composed mostly of private patients over whom he had relatively good control, and while not all have appeared as ordered, the large majority have reported regularly. To be sure, as Doctor Ashhurst has indicated, it is a bit too early to pass judgment in some of the cases. One should wait at least two years after operation before being certain of a non-recurrence.

Doctor Owen has pointed out that this particular technic is more complicated than the old Bassini operation and has suggested that it is not absolutely necessary in every case. He is quite correct. In a child, say of ten years

of age, suffering from a simple congenital hernia, with a small, thin sac and a ring the width of a lead pencil, the usual Bassini operation is almost certain to effect a permanent cure and this more elaborate operation may be dispensed with. He had been using this technic in practically all cases for purposes of practice and study, but its main indication is in old, large herniæ, especially in the direct variety and in recurrences, particularly in the types that were formerly considered incurable without some form of rectus muscle, anterior rectus sheath or free fascia transplantation.

With the rarest of exceptions, he had had splendid success with local anæsthesia. In this last series there was only one case in which he was forced to switch to general anæsthesia because the patient was so neurotic. He was so unreasonable that he began to cry out at the first needle prick and he really should never have tried to continue with local anæsthesia. Formerly he frequently took out the appendix in a right-sided hernia under local, infiltrating the mesenterium before ligating. He had found, however, that the search for the appendix and the drag on the mesentery during its delivery gives the patient an uncomfortable colic and now, when he does an appendectomy, he gives the patient a few whiffs of nitrous oxide while locating and removing the appendix.

He had found that, just in those cases where the conjoined tendon is defective, the overlapping of the external oblique aponeurosis beneath the cord compensates for that lack of development. In fact, it was to take care of this type of case that the idea originated. In these cases the external oblique aponeurosis is often well developed, sometimes actually hypertrophic, and the suture of the conjoined tendon to Poupart's could really be disregarded altogether.

He agreed with Doctor Jopson concerning the many current fallacies in views on hernia and he seconded his opinion as to the Fergusson type of operation without cord transplantation, especially as regards direct hernia. If it is admitted that non-transplantation of the cord is wrong in principle and favors recurrence in practice, then the maximum transplantation possible, as in the technic advocated, should be right and should offer the best chance of a permanent cure. Another fallacy that has persisted is the idea that covering the cord with the external oblique aponeurosis, allowing the cord to emerge obliquely, is necessary as a part of the hernial repair. Now when this is done and a recurrence develops, the new sac protrudes under the aponeurosis, indirectly through the old internal ring, or directly, medial to the epigastric vessels, irrespective of and in no way influenced by the aponeurotic covering over the cord. His plan is therefore to use everything available to strengthen the weak spot, which is all medial to the point of exit of the cord, whether the hernia be direct or indirect. It is of much more important to hug the cord, at its exit, as closely as one can with safety than to have it emerge obliquely. If there is a more or less straight emergence of the cord, without kinking or angulation, the snuggest possible suture of the ring may be made with the least chance of interfering with the testicular circulation.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held March 14, 1923

The President, DR. JOHN A. HARTWELL, in the Chair

INOPERABLE MELANOTIC SARCOMA OF THE NECK; ENTIRE DISAPPEARANCE UNDER ACCIDENTAL STREPTOCOCCIC INFECTION

DR. WILLIAM B. COLEY presented a girl about ten years of age, whom he said he had previously shown before the New York Surgical Society, in 1918, at which time she had remained well for three years; but the later developments had added increased interest to the case, making it worthy, in his opinion, of a second presentation. Doctor Coley, in briefly reviewing the case (history published in full in the *ANNALS OF SURGERY*, 1918), said that an exploratory operation had been performed in July, 1915, and a diagnosis of melanotic sarcoma was made by Dr. S. B. Moon, Pathologist of the Medical College of Virginia. This diagnosis had been confirmed by Doctor Ewing. The tumor steadily increased in size until December, 1915; the patient was becoming markedly emaciated, and her condition was regarded as absolutely hopeless. At this time she had an accidental streptococcic infection, with a temperature of 106; the tumor partially broke down, the remainder disappeared by absorption, and she remained in perfect health until the spring of 1920. At this time she developed a rapidly growing tumor in the right upper cervical region, involving the parotid. Doctor Coley's clinical diagnosis was round-celled sarcoma. The tumor was soft in consistence; no infiltration, and no discoloration. A portion of the tumor was removed for microscopical examination (Fig. 1) and pronounced round-celled sarcoma by Doctor Jeffries, pathologist of the Hospital for Ruptured and Crippled; diagnosis confirmed by Doctor Ewing. One radium-treatment, lead tray, was applied and the patient was put upon systemic doses of the mixed toxins of erysipelas and bacillus prodigiosus, which treatment was kept up for about four months. The tumor entirely disappeared in about four weeks, and the patient has remained in perfect health up to the present time, nearly three years later.

In his previous report, Doctor Coley called attention to the fact that in Escher's 68 collected cases of malignant tumors in which an accidental or artificially produced attack of erysipelas infection had taken place, great improvement in the local and general condition of the patient was noticed in the majority of the cases. In ten of twenty-seven cases of sarcoma, the tumor entirely disappeared, and nine were apparently cured. One of these cases was a melanotic sarcoma. Doctor

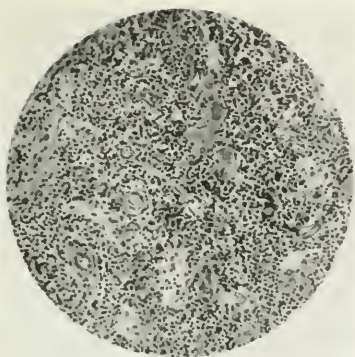


FIG. 1. Round-celled sarcoma.

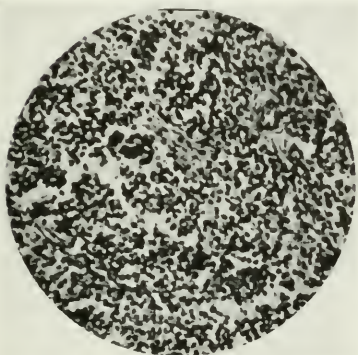


FIG. 2. Endothelioma (round-celled sarcoma).

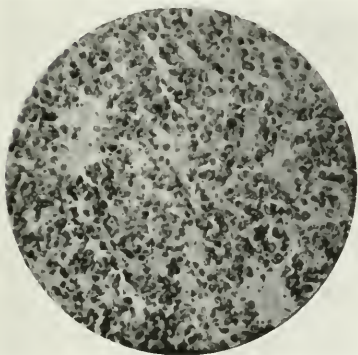


FIG. 3. Endothelioma (round-celled sarcoma).

PERIOSTEAL SARCOMA OF FIBULA

Coley added, that as far as he knew, this was the second case of melanotic tumor cured by accidental erysipelas or streptococcus infection, although several cases of inoperable melanotic sarcoma have been apparently cured by the mixed toxins, and well more than eight years.

PERIOSTEAL SARCOMA OF FIBULA

DOCTOR COLEY presented a case of periosteal sarcoma of the fibula with extensive metastases in the inguinal, femoral, and iliac glands, and in the lung; amputation; toxins and radium treatment; patient in good health two years and nine months after amputation.

The patient was a lad fifteen years old, who was admitted to the Hospital for Ruptured and Crippled in May, 1920. Family history negative. In January, 1920, the patient received a blow on the outer side of the right leg, followed shortly afterwards by pain. A few days later a swelling developed, apparently of bony origin, which increased in size until the end of March, 1920, when an operation was performed by Dr. Armitage Whitman at the Hospital for Ruptured and Crippled. Clinical and X-ray diagnosis: osteomyelitis; microscopical diagnosis: periosteal sarcoma. The tumor increased in size even more rapidly after the operation, and when seen by Doctor Coley in consultation, in June, 1920, the lower two-thirds of the fibula was occupied by a large tumor, apparently of periosteal origin, fungating in the central portion, at the site of the recent curetting. The glands in the groin were markedly enlarged. In view of the large size and rapid growth of the tumor, it was thought unwise to try any method of conservative treatment; immediate amputation was advised and performed by Dr. Armitage Whitman. Microscopical examination, round-celled sarcoma, periosteal. This diagnosis was confirmed by Doctor Ewing. The patient was then referred to Doctor Coley's service for toxin treatment, which was immediately begun and pushed to the point of producing marked reactions. This treatment was continued until the middle of August when, on account of the excessive heat, the patient was permitted to go to the country. One of the glands in the groin was removed in July, and pronounced sarcoma. Examination on his return to the hospital, October 23, 1920, showed that the glands in the groin had increased in size; there was a mass in the right iliac fossa, about the size of a child's head, apparently involving the retroperitoneal glands; and an X-ray picture of the chest showed well-developed, unquestionable metastasis of the lung. The patient was admitted to the Memorial Hospital on October 27, 1920, and received 10,109 mc. hours of radium over the right iliac region at a distance of 6 cm. An entirely hopeless prognosis was given to the family, who refused to have further treatment carried out, and the patient returned home. In May, 1921, I received word from his parents that the boy was attending school, and was in excellent health. In September, 1921, nearly a year after the last treatment, examination showed no evidence of any tumor in the abdomen or groin; and an X-ray picture of the chest showed the lungs to be normal. The patient was shown before the Memorial Hospital conference on December 23, 1922, in perfect health, and the latest

X-ray picture taken in March, 1923, two and one-half years after metastasis had been observed, showed not the slightest suspicion of trouble in the lungs. The microscopical section of the original tumor (Fig. 2) was later reviewed by Doctor Ewing, who classed this case in the group of endotheliomas; hitherto, these tumors were classed as round-celled sarcoma and are still so classed by most pathologists. An interesting point about them is that they are more malignant than the ordinary periosteal sarcoma and are more prone to metastasize. Sufficient time has not elapsed to classify the present case as a cure; nevertheless it is of extreme interest, as it is one of the very few cases of periosteal sarcoma with metastases in the lungs that has remained well for any considerable period of time.

DOCTOR COLEY presented a case of periosteal sarcoma of the upper half of the femur, with pathologic fracture, and probable metastasis of the spine; recovery under toxins and radium; well at present one year and eight months.

The patient was a woman, forty-four years old, who was admitted to the Memorial Hospital in July, 1921, with the following history: In the fall of 1919, while adjusting a window shade, she fell, striking her hip on the sharp edge of a piece of furniture. In the winter of 1920, she noticed numbness in both feet and began to limp, being obliged to use a cane; was treated for rheumatism. The condition gradually grew worse during the winter and in January, 1921, she was treated for a short period at the Neurological Institute. She was later admitted to the New York Hospital for Deformities and Joint Diseases, where an X-ray picture was taken and a diagnosis of tumor of the femur was made. In February, 1921, she was examined at the Memorial Hospital; and an X-ray picture was taken by Doctor Quick, who regarded the condition as hopeless; no treatment was advised. In March, 1921, she entered Mt. Sinai Hospital and was placed under the care of Dr. Howard Lilienthal and Dr. H. Neuhof. By this time, a pathologic fracture had occurred. An exploratory operation was performed in the latter part of March, revealing a large tumor, which involved the upper third of the femur. A portion was removed for microscopical examination and the diagnosis of perithelioma was made by Doctor Mandlebaum; after further study, his final diagnosis was: "Plasma cytoma—a malignant tumor originating in bone-marrow and chiefly made up of plasma cells." Complete loss of power developed in the left leg and partial loss in the right, pointing to probable involvement of the spine. The condition was therefore regarded as absolutely hopeless and the patient was referred to the House of Calvary, a home for incurable cancer cases. In the early part of July, the patient's husband was referred to Doctor Coley by Dr. Robert T. Morris, and consulted him in the hope that something might be accomplished by the toxins treatment. After obtaining a careful history of the case from Doctor Quick and Doctor Lilienthal, Doctor Coley gave an absolutely hopeless prognosis and declined to see the patient. The husband returned on the following day to Doctor Coley, who finally consented

PERIOSTEAL SARCOMA OF FEMUR

to examine the patient. She was brought to the hospital in an ambulance. Physical examination showed a tumor involving the upper half of the left femur; the patient was greatly emaciated, and was unable to move the left leg; only slight motion in the right leg. The tumor evidently was of bony origin. There was a pathologic fracture at the middle and upper third of the femur. X-ray picture taken showed involvement of the upper third of the femur for about seven inches, with a pathologic fracture in the centre. On account of the large destruction of bone, it was impossible to say definitely whether the tumor was of central or periosteal origin. Buck's extension was applied. Doctor Coley still regarded the condition as apparently hopeless and doubted very much if any temporary improvement worth while could be obtained from the treatment. The toxins were given in gradually increasing doses up to the point of producing marked reactions, temperature of 103-104, and continued up until the middle of September, 1921. At the end of two weeks, marked improvement in general health was noticed; and an X-ray picture taken at the end of the month showed local improvement in the tumor; no further extension of the disease, and beginning regeneration of bone. In the middle of September, 1921, one radium pack treatment was given (10,000 mc. hours at 6 cm. distance); and the toxins were continued. Buck's extension was removed in October, 1921, and in December a Thomas splint was applied. The patient was then able to get about in a wheel chair, and had gained twenty pounds in weight. By January, 1922, she was gradually regaining power in her limbs, and a plastic operation was performed to lengthen the tendon Achilles which had been greatly contracted during the long period in bed.

The patient has had no further toxin or radium treatment since January, 1922. She is now in excellent general condition. While she still uses crutches, she can walk without support. X-ray shows firm union of the bone and no evidence of a recurrence of the disease. X-ray picture of the chest fails to reveal any evidence of metastases. Doctor Ewing made a careful study of the microscopic section.

According to Doctor Ewing's classification, this case should be placed in the same group of endothelial myelomata, or endotheliomas, as the preceding case (Fig. 3).

PERIOSTEAL SARCOMA OF FEMUR

DOCTOR COLEY then showed a patient whom he had presented to the New York Surgical Society about two years before, with a history of a very large, inoperable, periosteal sarcoma of the upper two-thirds of the femur, following a recent fracture; pathologic fracture; complete destruction of five inches of bone; disappearance of tumor under combined toxin and radium treatment; reunion of bone. Patient well, with a useful limb, five and one-half years later.

A full history of this case, with photographs, will be found in the Transactions of the American Surgical Association, 1919.

DOCTOR COLEY showed an X-ray picture of the femur before treatment had been started, which had not been previously shown nor in-

cluded in any of the published articles. He also presented a lantern slide of a recent picture showing firm union of bone. The patient is now in perfect health, working in the Singer Sewing Machine Factory, and gets about without any support.

DOCTOR COLEY said that this case had been regarded as absolutely hopeless by every member of the Memorial Hospital conference; that while no microscopical section had been made of the tumor, the history of rapid growth, enormous size, and typical clinical picture, left no ground for doubt as to the correctness of the diagnosis.

DR. THEODORE DUNHAM said that apropos of these cases of Doctor Coley's, he was reminded of two cases which had been in his care about thirty years ago, one in which an erysipelatous infection had cured the patient and another which he had treated with Doctor Coley's erysipelas and prodigious toxins. The first case came under his care while he was assistant to Doctor Abbe, a child about two years old having an enormous tumor inside the cranium, bulging out the right eye from its socket and involving the temporo-frontal region so that the skull was absorbed and a softly fluctuating tumor presented. An exploratory operation was done, a piece of the tumor was cut out, it was examined and was pronounced to be endothelioma. The case was considered hopeless. He asked Doctor Abbe to allow him to treat the patient with Doctor Coley's toxins, and did so for six or eight weeks, giving what doses could be tolerated. During that time the tumor did not make any progress, whereas up to then it had been rapidly progressive, but seemed to become smaller. The child was sent home for a period of a few weeks, after which it was brought back for another course of treatment lasting a number of weeks, and the child then went home for good. Doctor Dunham saw the patient eight or ten years afterward and, though there was still some bulging, the growth had come to an entire standstill. The other case, although not a case of malignant disease, was interesting in this connection in that it presented an instance of a growth of abnormal tissue which was selected for destruction by an attack of erysipelas. The patient presented a large angioma on the abdomen, such as is found at birth. Doctor Dunham planned to remove the tumor by operation, but before the operation could be performed the patient came down with an erysipelas, which included the whole abdomen, and the child was very sick, with a high fever. The tumor shared in the erysipelatous infection, became necrotic and sloughed away, leaving a clean, crisply outlined, granulating crater. The tumor had been destroyed by the erysipelatous infection, while the surrounding normal tissues fully recovered. Here was a clearly selective action of the infection upon the tumor. These cases occurred before the discovery of either radium or the X-ray.

DR. EDWIN BEER, referring to the radiogram of the periosteal sarcoma of the femur in the third case, recently taken out of town, in which the shaft of the femur is shown broken close to the trochanter, said that he had noticed

that at the lower end near the centre of the femur there is an area which looks like *ostitis cystita fibrosa*, and it raised the question in his mind, was the first lesion of this nature?

DR. ROYAL WHITMAN, referring to the radiogram of the fourth case presented, said that if Doctor Coley had known the tumor was to disappear, he doubtless would have placed the shaft in extreme abduction to correspond to the position of the upper fragments. The angulation at this point and the persistent adduction of the limb accounts for much of the shortening and disability.

DR. JOHN A. HARTWELL expressed his belief that the problem of the value of the treatment described by Doctor Coley will ultimately have to be settled by the morphologists, the men who are studying the histology of tumor conditions. Doctor Coley reported that the diagnosis of the type of tumor he was dealing with, has been changed in one or two instances of the cases shown. These cases have many characteristics of malignancy. As he recalled Doctor Coley's previous reports good results may be obtained in about 10 per cent. of the cases treated while the remaining 90 per cent. are uninfluenced. It hardly seems probable that the same tumor is influenced in such a variable way by the same means of treatment, and it must therefore be that while our present knowledge does not permit us to properly classify these tumors, there is an essential difference in their biology. If they are all of the same type there is no explanation for some of them responding so successfully while others are so resistant to his treatment. It would seem that the true answer as to its value cannot be given, until there is a further differentiation possible which will separate these tumors more specifically, and it may be that therapeutic response will be the means of finally accomplishing this differentiation.

DOCTOR COLEY, in closing the discussion, first took up the point that had been raised by Doctor Hartwell. He said that anyone who had made an extensive study of sarcoma of the long bones knew that it was impossible to place them all in a single class or group; but that they should be divided into a number of fairly well-defined groups. For example, the group of central endosteal tumors made up chiefly of the giant-celled type; if seen in an early stage most of them were benign, in this sense they did not metastasize; many of these may be cured by simple curetting and carbolic acid. In some of the cases of this group, especially those in the more advanced stage, the diagnosis is extremely difficult; for in addition to the giant cells, there are often present a considerable number of spindle cells, and it may be impossible for the most expert pathologist to definitely determine whether a case is malignant or benign. Several of these cases, in Doctor Coley's experience, have ended in death from metastases. While amputation has been the rule in this group of central sarcomas, in most cases it has been found possible to save the limb by conservative methods: toxins, or radium, singly, or combined, with or without curetting.

There is another group, however, of the so-called sclerosing type, with a large amount of very dense new bone formation. In this type, Doctor

Coley stated, he had never seen a case saved by conservative treatment; neither toxins nor radium had any marked effect on the tumor, and only amputation followed by prophylactic toxin treatment gave any hope of saving the patient's life. In such cases, amputation should be performed early and in no way delayed by any trial of conservative methods.

There is still another group of cases, which hitherto had been called round-celled sarcoma, but which now is classified by Doctor Ewing as endothelioma or endothelial myeloma. This group, clinically, can be fairly definitely differentiated from the other types of bone sarcoma. It is usually characterized by extensive thickening of the shaft and involvement of the shaft rather than the extremities. There is very little new bone formation, as shown by the X-ray pictures. Marked destruction of the bone, followed by pathologic fracture, is not infrequently observed; and this type of tumor is especially prone to metastasize in other bones as well as in the lungs. Howard and Crile, in 1905, were the first to make a study of this type of tumor, endothelioma of the bone; and they published a series of 23 cases, 19 collected from the literature and 4 personally observed. The most interesting point brought out by their study is, that this type of tumor is the most malignant of all types of bone sarcoma, only one of the twenty-three cases having recovered from high amputation and well for three years. Another interesting point is, that this type is more prone to metastasize than any other type of bone sarcoma, metastases having been noted in sixty-six per cent. of Howard and Crile's cases. Doctor Coley stated that metastases had been noted in nearly all of the cases observed at the Memorial Hospital.

As to the question raised by Doctor Beer as to the possibility of the diagnosis in the third case presented this evening being osteomyelitis. To this Doctor Coley replied that, clinically, this tumor had all the aspects of a malignant tumor: it had developed—as is so often the case—shortly after a fall; it had steadily increased in size until it had finally produced a pathologic fracture, with probable metastases in the bones of the pelvis or lower spine. The patient at no time had had any temperature nor was there any other evidence of an inflammatory condition. Macroscopically, on exploratory operation, it showed every evidence of being sarcoma; and all of the pathologists who had examined it, including Doctors Mandlebaum, Ewing, Wolbach, Mallory, and MacCarty, were unanimous in the opinion that it was a malignant tumor.

As to Doctor Whitman's suggestion that in Case IV, in which there was five inches shortening of the femur, the leg should have been put up in abduction: Doctor Coley replied that it was kept in the Buck's extension most of the time while the patient was in the hospital; that very little attention was paid to placing the leg in perfect anatomical position, for the reason that no one believed there was one chance in a thousand of saving the patient's life. It was regarded as such a hopeless case, that Doctor Coley was criticised for having the patient occupy a hospital bed for eight months.

To Doctor Dunham's question, as to whether radium was always used with the toxins, Doctor Coley replied that, during the past seven years at the

FRACTURES OF THE FEMUR IN CHILDREN

Memorial Hospital, they had been trying several methods of treatment of long-bone sarcoma, using radium alone for one group, toxins alone for another, radium and toxins combined for another, and radium and X-ray for another. The results in this series of cases will shortly be published. So far, the only cases of long-bone sarcoma that have recovered under radium alone, or X-ray alone, and have remained well for over three years, have been of the central giant-celled type. Better results have been obtained with a combination of the local effect of radium and the systemic effect of the mixed toxins, than by the use of either agent alone.

MULTIPLE HERNIÆ, INGUINAL, FEMORAL, EPIGASTRIC

DOCTOR COLEY showed a recent case that had been operated upon eight weeks ago for inguinal, femoral and epigastric hernia. He said that while it was not infrequent to find several varieties of hernia in the same individual, in his thirty-three years' experience at the Hospital for Ruptured and Crippled, he had never before seen this particular combination. In 9750 operations for hernia at that hospital, only twenty cases of epigastric hernia have been observed.

FRACTURES OF THE FEMUR IN CHILDREN

DR. CARL G. BURDICK presented nine children illustrating the paper of the evening. For this paper, see vol. lxxvii, p. 736.

DR. EDWARD D. TRUESDELL called attention to the making up of shortening following fractures of the femur in children and in the consequent elongation of the extremity that was not uncommonly observed. Two years ago he had presented before the society, five children having inequalities of the lower extremities following fractures of the shaft of the femur. These fractures had varied in situation and variety. They had been variously treated, by simple end-to-end reduction; by the Steinman pin; the tongs; or the Lane plate. Four had shown some degree of shortening at the termination of treatment. All had finally presented some degree of elongation, this varying from one-half inch to even an inch.

A year ago the speaker had read before the society a paper on fractures of the femur in children, representing that part of an investigation of all fractures treated at the St. Mary's Hospital for Children during a period of five years. There had been 40 fractures of the femur and 27 of these had been seen and examined, periods of from six months to more than four years having elapsed since the injury. Of 11 cases that had been shown, some degree of shortening at the termination of treatment, 5 had returned to equality, and 6 had proceeded to elongation, more or less marked. Six cases had presented no primary or late inequality. Three cases had shown an inch of shortening at the termination of treatment and all three had almost completely compensated for the disparity. Thus in 14 of 27 cases investigated the stimulation of bone growth was clearly manifest, while in only one case was there no tendency to compensate for shortening, and this had been the only case in the series that had shown disinclination to callus formation and normal bone repair.

The speaker believed that moderate degrees of shortening at the termination of treatment were not unfavorable but that primary angular deformities should be corrected if possible, since these were the source of the usual permanent distortions of the bone. The pin or calipers were very useful to prevent excessive over-riding, rather than to eliminate lesser degrees of shortening.

In his experience marked degrees of inequality of the lower extremities following fractures of the shaft of the femur in children were not due to persistent shortening because of uncorrected over-riding of the fragments, but were due to elongation of the injured limb. Inequality due to lengthening has been found at times to be the cause of obvious tilting of the pelvis with compensating curvature of the spine.

Apparently a brief period of stimulation of bone growth very commonly accompanies injuries to the femur in children, and where this is excessive and is a source of inequality this inequality is permanent, since it has been found to exist ten years after the injury.

The speaker also corroborated Doctor Burdick's observation that firm union was regularly obtained in those cases where only cortical apposition of fragments existed provided that ample time was afforded.

DR. FRANK S. MATHEWS referred to a recent case of fracture of the femur in a child which he had seen some time after the receipt of the injury, when the over-riding was considerable. Some persons interested in the case had urged open operation; at that time he had asked a number of surgeons whether they had ever seen an adult with a persistent limp as a result of a simple fracture of the shaft of the femur in childhood. He had been unable to learn of a single case of the sort. His experience led him to concur in the methods of treatment advocated by the writer of the paper, and in complicated cases he used skeletal traction to the almost complete exclusion of open operation and plating.

Stated Meeting Held March 28, 1923

The President, DR. JOHN A. HARTWELL, in the Chair

MYXOSARCOMA OF THIGH INVOLVING THE FEMORAL VESSELS

DR. HAROLD NEUHOF presented a man, thirty years old, who had been admitted to hospital on account of a progressively increasing swelling in posterior aspect of left thigh, of one year's duration.

Upon examination there was a large tumor mass occupying the lower half of the thigh down to the popliteal region. It measured 7 by 6 inches. It was of semi-solid consistency and appeared closely related, but not attached, to the femur. There was no evidence of interference with the circulation other than dilated veins in the skin over the tumor. Upon exploration with the needle blood was obtained. A specimen was removed in which it was difficult to differentiate between myxoma and myxosarcoma.

TREATMENT OF HAND INFECTIONS BY ACTIVE MOBILIZATION

At operation, July 22, 1922, a free incision was made, and the sciatic nerve was found spread out and flattened over the superficial surface of the tumor. The latter had a well-defined capsule on the surface, but this was lost in the depths. The neoplasm was lodged between the inner and outer hamstring muscles, displacing them. On the superficial surface and to a more marked extent than the deep surface there were a number of greatly dilated veins. The sciatic nerve was dissected free, the veins running into the capsule tied off, and the neoplasm dissected free to the region of the femoral vessels. The latter were isolated above and below the neoplasm but were definitely incorporated in part in the growth. The femoral vein was found intimately fused with the tumor for a distance of 6 cm. Here its wall was white, thickened and firm in consistency, the lumen being evidently occupied by solid material. In this region the arterial wall was also attached to the neoplasm for about 2 cm. The femoral vein was resected beyond the involved portion. Serrefines were then applied to the femoral artery above and below, and the wall of the latter where it was involved by the neoplasm was resected for a length of 2.5 cm. The lumen of the artery was found to be free. It was irrigated with 3 per cent. sodium citrate solution and subsequently with normal salt solution. Suture of the oval arterial defect was made with Carrel silk and fine needles. The suture was continuous, approximating intima to intima, and resulted in the reduction of the diameter of the artery by one-half. Upon removal of the arterial clamps there was oozing at several places requiring reinforcing suture. Through pulsation of the artery was noted. Soft parts and skin were closed in the usual manner.

It is now nine months since the operation. Patient has remained free from recurrence. There is normal function in the extremity except for slight limitation of flexion at the knee. The dorsalis pedis and posterior tibial arteries at the ankle, in which pulsation was present directly after the operation, have remained patent and the circulation in the leg has been free from interference.

TREATMENT OF HAND INFECTIONS BY ACTIVE MOBILIZATION

DR. CHARLES L. GIBSON said that lessons taught by the war and particularly the renaissance of the ideas of Lucas Champonniere and their very practical application by Willems to the surgery of purulent joints has probably made all surgeons seek to apply this method to other forms of suppuration.

Since 1918, he had sought to get early motion in hand infections; but the principle was developed in only a rather desultory manner until recently, since when it has been systematized. The practical problem was to give the patient sufficient freedom of hands and fingers under a suitable dressing. Definite progress was made when Dr. Clay Ray Murray took hold of the matter and encased these hands in an electric light bulb. (Fig. 1.) Hand and fingers could then be worked freely, the secretions being caught by suitable dressing surrounding the cage.

At present our method is an exact imitation of Willems' method: the making of suitable incisions, no packing, and no dressing is put on the hand.

It is simply confined in a cage and the patient is instructed, or better, made to flex and extend the fingers very frequently. Applied in this way the patient has a chance to exercise the hand before there is any stiffness to overcome, and it is surprising with what little pain this procedure can be carried out. The intelligent patients coöperate very readily. Per contra, if the patients are stupid or balky it had better not be tried.

All the patients treated in this way have finished with perfectly functioning hands and fingers, and with a minimum of atrophy of the muscles. The bulk of these patients have been healed up more quickly by this than by the older methods.

In illustration he presented the following patients:

CASE I.—Male, age twenty-five, admitted February 1, discharged February 10, 1923. There was no history of trauma, the patient coming in for treatment of a cellulitis of the palmar space which he had first noticed ten days previously. There was progressive pain and swelling. The "sore spot" had been "opened" in the admitting room three days previous to admission. He was admitted with a painful, useless, red and swollen hand. There was a two-inch incision in the palm exuding pus, redness and swelling of the forearm with red streaks of lymphangitis of arm. Temperature 102° , pulse 88, respiration 22. The palm incision was extended one inch and into palmar space; thenar space was opened by incision back of web of thumb under ether anæsthesia. The cage was then applied.

CASE II.—Male, admitted March 22, 1923, not yet discharged.

Five weeks before admission caught his hand on a nail going quite deeply into the palm of the left hand. Hand began to swell the next day. Incision four days later by outside physician over swelling in palm. Several subsequent incisions made at different times. Hand kept getting worse.

Patient admitted to the hospital March 22, 1923. Local condition: marked swelling over the hand extending to the wrist. On motion there was marked limitation of flexion and some limitation of extension with limitation of motion at the wrist joint.

Incisions made in centre of palm and over centre of wrist March 23. Cage applied.

CASE III.—Woman, one week before admission noticed painful callous-like spot in palm of hand. Whole hand quickly became swollen. Three incisions (February 20, 21 and 24) made by outside physician. Condition became steadily worse.

Admitted February 26 with swelling of whole dorsum of hand, forearm and upper arm. Marked tenderness with restricted motion. Palmar and dorsal incisions February 26 under ether. Cage applied.

Discharged March 1, 1923.

DR. CLARENCE A. McWILLIAMS did not see how, if these were simple subcutaneous infections, mobilizations could materially increase the drainage. If, however, the sheaths were involved, motions of the contained



FIG. 1—Infected hand encased in an electric light bulb

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COLECTOMY FOR CHRONIC INTESTINAL OBSTRUCTION

tendons would undoubtedly facilitate external drainage through adequate incisions. Whether such motions would spread the infection further up and down the sheaths and thus act injuriously, further experience alone would tell. There probably would be no deleterious effect because drainage always occurs towards the place of decreased pressure, in this case through the incisions. The great advantage of these mobilizations lies in the lack of the necessity for gauze or rubber tissue or tube drains, hence one would expect less liability to tendon sloughs. If this revolutionary method of treating tendon infections should prove as successful as Willens' method of treating joint infections, it will indeed be a wonderful advance.

DR. WALTON MARTIN questioned whether the very excellent results in the cases shown were due to the active mobilization or to correctly placed incisions insuring proper drainage without gauze drainage. He felt sure that many of the bad results in the past had been due to the tissue damage done by improper gauze packing. He found it difficult to believe that there was any sound biological basis for the opinion that active mobilization of the tendon in the tendon sheath limited infection.

DOCTOR GIBSON said that the cases he presented had been chosen at random; in two of the cases the tendon sheath was involved. Every patient treated by this method has done exceedingly well and has a good functioning hand. Results like these in infections of the hand are not very common.

COLECTOMY FOR CHRONIC INTESTINAL OBSTRUCTION

DR. WALTER A. SIHERWOOD presented a woman, twenty-seven years of age and a graduate nurse by occupation, whose chief complaints were recurring attacks of indigestion, associated with vomiting, right-sided abdominal pain and increasingly obstinate constipation. These attacks had been increasing in frequency and severity for the past year.

In 1910, she was operated on for supposed appendicitis; the incision made at that time was small and apparently the abdomen was not explored. She was again subjected to operation at various hospitals in 1912, 1914, and 1919 for post-operative adhesions and symptoms of intestinal obstruction. She experienced temporary relief after each operation, but again became incapacitated on several occasions while on duty at the Brooklyn Hospital, because of severe attacks of abdominal pain accompanied with nausea and constipation.

A careful study of her condition was made and further surgical intervention was not advised until January of this year, when she grew progressively worse. When admitted for further observation she was having more or less constant pain and was extremely tender over the entire right side of the abdomen. Nausea and an inability to take food had resulted in a marked loss of weight together with body dehydration. A further gastrointestinal X-ray study showed evidence of obstruction in the low lying cæcum and ascending colon. Her condition was such that operative measures again seemed imperative, and after several days of forced fluid administration the abdomen was opened through a long right

rectus incision. There were no adhesions, bands or pericolic membranes, but there was a generalized visceroptosis, the stomach, cæcum and transverse colon being especially low in the pelvis.

The terminal ileum, entire cæcum and first third of the transverse colon were enormously dilated and entirely flaccid, producing a condition which was interpreted as chronic adynamic ileus. The findings and history of this patient seemed to warrant extreme measures for her relief, and it was therefore decided to remove that portion of the bowel which was involved in the pathology described. Six inches of the terminal ileum, the cæcum and ascending colon together with the first half of the transverse colon were resected and a side-to-side anastomosis was effected between the ileum and transverse colon, close to their resected ends. The operation was rendered simple by careful attention to the blood supply, the use of Payr clamps and the prevention of soiling by means of cautery resection with careful infolding of the ends of the bowels with three rows of chromic sutures.

All raw surfaces were peritonealized and the operation completed in the usual manner. Twenty-four hours after operation the patient went into severe secondary shock with rapid feeble heart action and very low blood pressure. This was associated also with frequent attacks of regurgitant vomiting, apparently the result of post-operative intestinal paresis and reverse peristalsis.

Syncope and hiccough, frequently repeated, added to the gravity of the condition, but continuous hypodermoclysis and frequently repeated gastric lavage resulted in a gradual improvement, and on the fifth day a normal fecal current was established, after which recovery was rapid and uneventful. The patient left the hospital at the end of three weeks in excellent condition and with a solidly healed wound. Now, at the end of two months, she is entirely free from all symptoms and is rapidly gaining in weight. She eats heartily, has no indigestion, nausea or pain, and for the first time in years is not in need of cathartic drugs.

DOCTOR SHERWOOD further observed that although the misapplication of this procedure has resulted in many disappointments and surgical failures, there is nevertheless a distinct group of cases in which the disability is so well marked and easily recognizable as to warrant the most radical measures for relief. It has been his experience that when properly selected for operation, patients suffering from extreme degrees of intestinal stasis with prolapsed cæcum or colon and a loss of muscle tonus sufficient to produce symptoms of chronic or intermittent obstruction, lend themselves well to the operation of colectomy and obtain marked or complete relief with much improvement in general health.

In his hands, attempts to anchor or fix the colon with sutures have not been permanently satisfactory, and it is his feeling that if surgical measures are at all indicated nothing short of the complete operation may be counted on to secure permanent relief.

ACUTE OBSTRUCTIVE DUODENAL ULCER

DOCTOR SHERWOOD presented the following cases:

CASE I.—A man, twenty-five years of age, who entered hospital because of severe upper abdominal pain of ten weeks' duration. He had no history of long continued digestive disturbance but one month before coming under observation he had been seized with generalized abdominal pain and vomiting. He has never vomited blood, but stated that his stools had been very dark in color.

Examination of the abdomen, which was tensely held, revealed nothing but tenderness on deep palpation in the epigastrium and the right lower quadrant. The laboratory tests, Ewald meal, and gastro-intestinal X-ray study were of no value in establishing a diagnosis. The clinical history was such, however, as to warrant the assumption of definite pathology, and on opening the abdomen there was found to be a well-marked acute ulcer on the anterior surface of the first portion of the duodenum. There were numerous adhesions and a red angry appearance of the tissues surrounding the ulcer together with œdema and swelling sufficient to produce pyloric obstruction.

Radical extirpation of the acutely inflamed ulcer area seemed unwise and a simple posterior no loop gastrojejunostomy was done together with a removal of the appendix which was definitely infected. Recovery of this patient was rapid and uneventful, and he has obtained complete relief from all symptoms. He reports that he is gaining rapidly in weight and has no discomfort of any kind.

CASE II.—The second case is a man, sixty-eight years of age, who was well until nine months before entry into the hospital. He then began to have distress after eating, associated with eructations of gas. These symptoms persisted with increasing severity, and for the past three months he has had sharp pain in the upper abdomen without reference to meals, increasing constipation and much prostration. For three weeks previous to admission to the hospital he had complete anorexia, vomited frequently and passed blood in his stools. He lost about forty pounds in weight and was greatly annoyed by persistent hiccough.

Examination on admission revealed an elderly man, much emaciated and apparently very ill. The physical findings were irrelevant except for tenderness in the right hypochondrium and the suspicion of a tumor in the region of the pylorus. Hæmoglobin 60 per cent., blood examination and cell count otherwise negative. Test meal showed almost complete absence of free hydrochloric acid and only 2 c.c. of total acids after 80 minutes.

There was much occult blood found in several stool examinations. The entire clinical picture and history presented in this case were highly suggestive of malignant disease, and such a diagnosis was made previous to operation, although the X-ray study in this case was in no way suggestive of gastric carcinoma, a study of all films being diagnostic of obstructing duodenal ulcer and so reported by the röntgenologist, Dr. Ruth Ingraham.

At operation a small semi-solid tumor was found involving the first portion of the duodenum and almost completely obstructing the pyloric outlet.

On careful examination, this mass was found to be a large soft ulcer, surrounded by inflammatory exudate. It was in no way suggestive of carcinoma and there were no glandular enlargements.

Here again, it was considered unwise to subject this patient to a radical excision of the ulcer and a simple posterior no loop gastrojejunostomy was done in the usual manner. The appendix which was pathological was also removed. The patient made a prompt and uneventful recovery and has experienced complete relief from all symptoms. He is gaining in weight rapidly, and it is evident that the obstructive process was the principal factor in the production of his most serious symptoms.

DOCTOR SHERWOOD further remarked that the present tendency to excise or to do some type of pyloroplasty or extensive resection of ulcer bearing areas has an increasing number of advocates. It may be admitted that this principle is sound in the chronic indurated and non-obstructive ulcers, particularly those which involve or deform any portion of the stomach, and in which the later development of malignancy may be a factor.

In obstructive ulcers, however, which involve only the first portion of the duodenum, as in the two cases reported, where malignancy very seldom or never occurs, he was still of the opinion that simple posterior gastroenterostomy is a highly satisfactory procedure and is followed in most instances by complete and permanent relief. It is also his practice in such cases to remove the appendix and to take care of coexisting pathology in the gall-bladder; factors of undoubted importance in the etiology and continued or post-operative activation of ulcer symptoms.

HEALED TROPHIC ULCER OF AMPUTATION STUMP FOLLOWING PERI-ARTERIAL DECORTICATION

The detailed report of this case is embodied in the paper of the evening, for which see page 321.

EXCISION OF ADVENTITIA OF BRACHIAL ARTERY (LERICHE OPERATION) FOR RAYNAUD'S DISEASE

DR. HAROLD NEUHOF presented a woman, forty-one years old, who came under observation on the First Surgical Division, Bellevue Hospital, in July, 1922, with a typical history and clinical picture of Raynaud's disease in the upper extremities.

In her previous history the salient features are the use of coffee and cigarettes in great excess, alcohol in moderate excess. Menstruation ceased at the age of twenty-six. Five months before she was admitted, the symptoms began in both hands, consisting in attacks of coldness and numbness in the finger tips which became dead white for varying intervals. Following the period of pallor the fingers would become purple

and exquisitely sensitive. These manifestations soon ceased in the left hand but continued and became progressively more severe in the right. Gangrene of the index finger of the right hand developed and was progressive.

Physical examination revealed no evidence of arteriosclerosis, but the left radial pulse could not be felt. Pulsation of the vessels in the right upper extremity was normal. There were spots of necrosis at the tips of several fingers and gangrene of the distal portion of the right index finger. During the period of observation before operation the patient suffered severely with pain in the right hand coming on at frequent intervals, during which time ischæmic manifestations were noted.

Amputation of the finger was clearly indicated, but it was also evident that this would not relieve the severe pain and circulatory disturbances in the right hand and that repair of the amputation stump would not be good because of the poor circulation. It was therefore decided to operate according to Leriche first, and to amputate at a later sitting.

At the operation on the brachial artery the adventitia was removed for a length of about 7 cm. No constriction or dilatation of the artery was observed. The pulse was present at the wrist directly after operation. Relief of pain in the hand began within twenty-four hours and the patient remained free from manifestations of circulatory disturbances. The pain about the gangrenous finger persisted, however, and amputation was done about two weeks after the Leriche operation. The amputation stump healed by primary union. It is now eight months since the operation and patient has remained entirely free from pain and circulatory disturbances in the right hand. The circulation is good and has not been otherwise even in cold weather, or in the occupation of the patient involving immersion in cold water upon frequent occasions.

THE RELATION OF SURGERY TO CERTAIN DISTURBANCES OF THE VASCULAR SYMPATHETIC SYSTEM

DR. WALTER A. SHERWOOD read a paper with the above title, for which see page 321.

DR. DEWITT STETTEN said that he had attempted the Leriche operation in two cases of thrombo-angiitis obliterans which, however, he did not regard as an ideal indication for the operation. The first patient had a gangrene of the first, second and third toes of the left foot, redness and œdema of the foot and very severe pain. There was a good popliteal pulse. The femoral artery was exposed in Hunter's canal and about 8 cm. of the adventitia was excised. For three days there was no improvement, but after that the pain markedly diminished and the redness and œdema of the foot subsided considerably. The patient had been unable to sleep without sedatives and now managed to get a good night's rest without drugs of any kind. The gangrenous portions of the toes were then removed. The wounds at present are clean and show a healthy granulating surface, but recently the pain has recurred, although not quite as severely as before the peri-arterial sympathectomy. The second patient had a

gangrene of the fifth toe of the right foot. There was no popliteal pulse. Doctor Stetten attempted to expose the artery in Hunter's canal and found it imbedded in dense inflammatory cicatricial tissue, so that it was dissected out and separated from the vein with great difficulty. The artery was not pulsating, and on palpation, it was noted that a blood-clot broke up under the examining finger. With an assistant controlling the hemorrhage by digital pressure on the femoral pulse in Scarpa's triangle, a longitudinal arteriotomy was done. Part of the clot was extracted with forceps and the balance was irrigated out with saline solution or, loosened with a probe, it was allowed to shoot out with the blood stream by having the assistant release his finger from the vessel above. After the vessel had been cleaned upward as far as the groin and downward as far as the popliteal region, arterial blood was allowed to flow for a while, and then a Carrel suture of the artery was performed. It was obviously impossible to excise the adventitia. The artery was pulsating very well, as the superficial wound was closed. The patient was much improved in spite of the fact that the popliteal pulse could never be felt after the removal of the thrombus. Later the gangrenous toe was removed and the patient is now relatively comfortable, although it is possible that at least a portion of the vessel has been re-occluded.

DR. HERMANN FISCHER spoke of having had a similar experience to that of Doctor Stetten. His patient was suffering from arteriosclerotic gangrene of the second and third toes of his right foot. He was treated for several weeks with large doses of Ringer's solution (6 to 8 litres in 24 hours) which was introduced into the duodenum by the duodenal tube. As this treatment had no influence at all on the pain or the lesion, it was decided to give Leriche's operation a trial. The effect of the operation, however, was nil, and an amputation finally became necessary.

DR. JOHN A. HARTWELL said he had done the Leriche operation four times on three individuals. The first time was in the case of an old man with marked arterial changes. Circulation of the left lower extremity was so compressed that there had resulted a condition markedly similar to an ischæmic paralysis. A marked equinovarus had followed this, and there was a large pressure ulcer over the external malleolus. The entire leg and foot had the appearance of a cadaver, though no gangrene was present. No pulsation could be found in the vessels around the foot, though it was thought to be present in the popliteal artery. Amputation was done above the knee. Healing was prompt but there developed an exceedingly painful stump, without apparent cause. The pain was spontaneous and had nothing to do with pressure. He was admitted to the hospital several times for this condition, and finally about five months after the amputation a sympathectomy was done upon the lower external iliac and the common femoral artery. The superficial femoral artery, below the point where the profunda was given off, had no pulsation and seemed to be completely thrombosed. The profunda artery seemed to be the only source of circulation to the extremity. The Leriche operation was done in the typical

way for a distance of about three and one-half inches of the iliac and common femoral. Pulsation in the artery following the procedure seemed to be greatly reduced, but its lumen did not seem to become narrower. There was some question, therefore, as to whether Leriche's instructions had been fully carried out. He states that when all the sympathetic fibres are removed there will follow a very definite narrowing of the artery. Subsequent events have proved that the pain has been almost completely relieved. Sympathectomy was done nearly a year ago, and the patient has had only one attack of pain which occurred during the excessive cold of the past winter, and was completely relieved by a few days' rest in bed. The second patient was a Hebrew, aged forty-five years. He had had his left thigh amputated a year previous for what was presumably thrombo-angiitis obliterans, the symptoms of which had been present for three years. The stump, however, healed normally, and was without pain. The condition in his remaining foot was of short duration. He had some pain, but never serious until three days previously. There had rapidly developed a distal gangrene on the little toe of the right foot, and the great toe was distinctly purplish and tender. He was kept under observation for one month, during which time there had been some increase of the gangrene, with a great deal of severe pain. There was pulsation in the popliteal artery, but none could be felt in the ankle. The little toe was disarticulated at the metatarsal joint. One week later a sympathectomy was performed upon the common and superficial femoral arteries for a distance of about five inches. In this case there was a full contraction of the artery as indicated by Leriche as proving that the operation was correctly performed. Patient was discharged with the amputation stump healthily granulating, and he stated that the pain in the foot was decidedly lessened. Reported by letter to the follow-up clinic two months later that he was free from pain and that circulation in the foot seemed greatly improved.

The third patient was an Englishman, aged forty-seven years. There was no evidence that he had syphilis. Symptoms in his condition, however, represented those of an arterial sclerosis, though the type of pain and the slow development of the symptoms were more those of the thrombo-angiitis obliterans. When admitted to the hospital he had gangrene of the left foot, for which an amputation was done in the leg. Severe infection resulted and a second amputation had to be done in the thigh. At this time he was having very considerable pain and poor circulation in the other foot. A double sympathectomy was done upon him on October 24, 1922, at which time the stump was unhealed. Following this operation healing took place very kindly, and after a period of about six weeks he was entirely free from pain in the other extremity. He was seen at the follow-up clinic five months following the operation, when he had no pain whatever. Circulation in the foot seemed excellent, and the stump at the site of the amputation was healthy and soft. In this case the artery contracted to about one-half its normal size immediately on removing the adventitia.

The speaker's experience with these cases makes him believe that some benefit may be derived from this operation, both in cases of arterial sclerosis and in cases of thrombo-angiitis obliterans. If such prove to be the case it must be that the greater volume of blood allowed to enter the distal vessels overcomes the pathology which is threatening the life of the tissues.

DOCTOR NEUHOF said that he considered it difficult to understand how the Leriche operation could be of advantage in thrombo-angiitis obliterans. His own experience had been disastrous, the patient developing gangrene after operation, requiring immediate amputation. It was of interest to report that in a patient with advanced arteriosclerosis and severe pain in the lower extremities operated upon in Bellevue Hospital, great relief followed the Leriche operation on the femoral artery on the right side, whereas relatively little relief from pain was the sequel of the identical procedure on the left femoral artery. The pathology of the vessels was the same on both sides.

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MANAGEMENT OF INJURIES TO THE CRANIUM AND ITS CONTENTS*

WITH SPECIAL REFERENCE TO CEREBROSPINAL FLUID PRESSURE DETERMINATIONS

BY JOHN O. BOWER, M.D.

OF PHILADELPHIA, PA.

ASSISTANT SURGEON, SAMARITAN HOSPITAL
CLINICAL PROFESSOR OF SURGERY, TEMPLE UNIVERSITY

SINCE Kocher¹ and then Cushing² demonstrated the sequence of events which follow increased intracranial pressure on the medulla, there have been more accurate interpretations of the degree of bulbar compression. The



FIG. 1.—Case I, Private B. Compound comminuted depressed fracture with extradural hemorrhage.

local examination of patients with suspected intracranial injury, usually plays only a small part in determining whether or not immediate operation is indicated. A contusion with resultant swelling of the soft parts, a forceful

* Read before the Philadelphia County Medical Society, October 12, 1921.

separation of the temporal or occipitofrontalis muscle from the skull, at times precludes determining by palpation the exact bony pathology present; frequently the X-ray helps but little; if the bone lesion is extensive we do not need it, and if it is slight the röntgenographic evidence is no criterion to the degree of intracranial pathology.

Lecount and Apfelbach,⁶ in a study of 504 cases of skull fracture, found that 85 per cent. had a simple linear fracture, yet 94 per cent. of the brains of these individuals at operation or post-mortem, showed laceration or contusion. We should usually depend therefore on the result of a general



FIG. 2. Case I, Private B. Scar following debridement.

examination to guide us, especially symptoms from interference with circulation in the medulla. More attention has been paid to the study of the gross changes found at autopsy than to the pathologic physiology which accompanies the early or ante-mortem changes.

The pathologists say that the most frequent change in brains of patients dying from skull fracture is traumatic œdema, but this in itself is only partially enlightening. An injury which interferes with the nutrition of cerebral substance, whether it is a contusion, laceration or an extradural pressure, results in a passage of fluid into the substance with subsequent swelling and the "rigid enclosure" of the brain may finally produce a bulbar anæmia.

As the intracranial space is encroached upon in the early stages of bulbar compression, the cerebrospinal fluid is forced out of the cranial vault, then the blood in the veins and finally the blood in the capillaries, arterioles and arteries.

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During the process of evacuation of the spinal fluid and venous blood, no symptoms of any importance present themselves. Probably the eye-grounds during this stage would reveal changes of marked significance were they examined at frequent intervals. Just as soon, however, as the intracranial pressure becomes sufficiently high to force the blood out of the capillaries in the medulla, the stage of compensation Kocher describes begins; the vital centres suffer from the lack of oxygenated blood and the compensating mechanism increases the volume of air intake and raises the arterial tension.



FIG. 3.—Case II. F. W. Extensive laceration of right frontoparietal region with fracture and depression of inner table of frontal bone.

These are the changes which take place, generally, in the average case. It must be realized, however, that the degree of involvement of the vital centres depends on the severity and the situation of the cranial injury. In a fair percentage of head cases the damage to these centres has been so great that the patient does not react to shock and again there may be a localized area of brain entirely destroyed with no perceptible change in the protecting mechanism situated below the tentorium.

In one patient, who came under my observation, a man who was struck by an automobile and thrown against an electric light pole, a disc of bone about 1.5 cm. in diameter was driven directly into the speech centre; other than the slightly lacerated and contused scalp and aphasia, this patient presented no evidence of an intracranial involvement.

In these two types of cases the interpretation of the changes that take place in the medulla is not vital. The treatment is definite. Where the

patient reacts from shock, however, and passes into the stage of compensation the changes in the cerebrospinal fluid pressure, blood pressure, pulse and respiration must be accurately noted so that at any moment these readings may be converted into terms of medullary circulation.

Of secondary consideration, especially with reference to localization, are paralysis, ocular changes, increased, absent or diminished superficial and deep reflexes.

Cerebrospinal Pressure.—Much has been written about the advisability of doing lumbar puncture in the presence of increased intracranial tension. Cushing states that it is dangerous and that he has seen death follow the



FIG. 4.—Case II, F. W. Scar following debridement and decompression.

procedure. Sachs makes a similar statement. Frazier³ believes that lumbar puncture is essential. Sharpe⁴ advocates the use of the spinal manometer but states that "as a rule not more than 5 c.c. of cerebrospinal fluid should be removed at lumbar puncture for diagnostic purposes and no therapeutic attempt made to lessen the intracranial pressure if the ophthalmoscopic and spinal manometric tests have disclosed a high intracranial pressure." He reports three deaths in over sixteen hundred lumbar punctures. "In each case the lumbar puncture was performed by an inexperienced interne who held the erroneous belief that the purpose of the puncture was to remove as much of the cerebrospinal fluid as possible; two of these patients have had an intracranial tumor, one being subtentorial and the third having the condition of internal hydrocephalus." At the Samaritan Hospital, it has been

done routinely for seven years. There have been no deaths and I believe there is little or no risk to the patient, if a needle with a three-way stop-cock is used. If one has had any experience, a puncture may be done without losing more than a drop or two of cerebrospinal fluid. It would be dangerous to a patient to place him in an upright position, insert a spinal needle and permit the fluid to spurt out, inducing shock by removing the buffer between the skull and the medulla; but if the patient is in the lateral prone position and a needle with a stop-cock is used, this danger is entirely eliminated. The force with which the cerebrospinal fluid is ejected from the needle, in some



FIG. 5.—Case III, M. C. Compound comminuted depressed fracture of right frontal region associated with marked cerebral contusion.

cases, is no criterion of the degree of pressure within. On two occasions different surgeons of wide experience in doing lumbar puncture remarked upon the apparent lack of pressure, when observing the procedure, and were surprised to find that when the spinal manometer was attached the pressure was exceedingly high. Landon⁷ states that the normal cerebrospinal fluid pressure in the lateral prone position is four to eight mm. of mercury and in the upright position fifteen to twenty. Skogg⁸ states that a minimum figure can be placed at 90 and a maximum figure at 150 mm. water manometer (7 and 11 mm. of mercury). He does not mention, however, the position of the patient, or in which interspace the needle was inserted.

In several hundred observations we have found that the patient with a systolic blood-pressure of about 120 mm. of mercury and a diastolic of 85,

more frequently registers 4 mm. of pressure in the lateral prone and 12 to 16 in the upright position, when the needle is inserted into the second lumbar interspace. Inasmuch as the hydrostatic pressure is a contributing factor in the production of the pressure, the interspace selected and the position of the patient very definitely modify the pressure findings.

What degree of cerebrospinal pressure is abnormal? The presence of macroscopic blood in the cerebrospinal fluid and a pressure of 12 mm. of mercury in the lateral prone position should be considered sufficiently abnormal to require a reading every four hours. If the second reading shows that



FIG. 6.—Case III. McC. Defect following debridement and decompression.

the pressure has increased, enough fluid may be withdrawn to reduce the pressure to ten or twelve millimetres of mercury. If after eight hours there is an increase to twenty mm. or over and no improvement is noted, operation is indicated.

Blood-pressure.—Cushing² has emphasized the importance of blood-pressure readings in intracranial injury. It is being done more frequently and in most hospitals it is part of the routine examination of every head case. A point that I wish to call attention to, because it may be misleading and is also frequently overlooked, is the variation of the systolic and diastolic pressures in certain cases where the vital centres are laboring under considerable difficulty; one reading may show a systolic pressure of 100 and a diastolic of 100, another, within an hour, or within a few minutes, may show a drop

to a systolic of 120 and a diastolic of 50. These patients usually need prompt operative interference if they are to be saved. Occasionally a patient with a fractured skull and an associated heart lesion is observed, who, under normal conditions, has a very high blood-pressure. Recently such a case was brought to the hospital with a systolic pressure of 100 and a diastolic of 40 mm. of mercury, with symptoms of increased intracranial pressure; her cerebrospinal fluid pressure was 11 mm. of mercury in the lateral prone position. The fluid was clear, so the operation was deferred. In this case after 2 c.c. of cerebrospinal fluid were withdrawn the blood-pressure fell 20 mm. of



FIG. 7.—Case IV. M. S. Scars three months after trepanning in frontotemporal region; fracture of middle and anterior fossa with moderate cerebral contusion.

mercury. Within twelve hours the blood-pressure had regained ten points and at the end of twenty-four it had returned to 180 mm.

While we have found that increased blood-pressure frequently accompanies increased intracranial pressure, they are not always associated. From examinations of over two hundred patients who were subjected to spinal anæsthesia, I found that there was no constant direct relation between the cerebrospinal pressure and the blood-pressure, which confirms the observations of others.

Respiration and Pulse. The superficial breathing of the shocked patient, the slow, full or deep respiratory movements of one who is compensating from cerebral compression, and the Cheyne Stokes' breathing of the non-compensating are familiar and the significance of each is apparent. What may be

said of inspection as to respiration may be said of palpation as to the pulse, there is the weak, rapid pulse in the shocked, the slow, full pulse of the compensating and the weak racing pulse of the paralyzed medulla. A slow, full pulse is indicative of increased intracranial pressure, but the slowness of pulse rate is not always commensurate with the degree of cerebral tension.

Watchful Waiting Cases.—A full appreciation, then, of the four cardinal points mentioned is sufficient to determine whether or not a case is an operative or a "watchful waiting" one. If immediate operation is indicated, the finer points relative to physical findings are not necessary. One does not need



FIG. 8.—Case V, E. B. Traumatic thrombosis of the cavernous sinus with probable cerebral contusion, photograph shows exophthalmus and almost complete disappearance of cicatrix six months after operation for defect.

an ophthalmoscopic examination to see that a decompression is essential if hemiplegia is present, the pulse 48, the blood-pressure 180 and 70, and the cerebrospinal pressure in the lateral prone position at the second lumbar interspace 30 mm. of mercury.

Undoubtedly examinations of the eye-grounds are essential but such examinations may be reserved for the "watchful waiting" cases, and by this I mean cases of suspected fracture of the skull in which the surgeon decided after the usual routine examination that operation is not immediately indicated. These should be watched personally until they are clearly clean-cut operative or decidedly non-operative. There should be half-hourly charting of the pulse and blood-pressure; hourly examination of the pupillary reactions, deep and superficial reflexes, noting increase or decrease in voluntary move-

ments, etc. In the meantime the oculist should be consulted and the result of this examination charted. After four hours, if the indications for operation are still not definite, another spinal puncture should be made and the pressure taken. If the cerebrospinal pressure at the initial examination was above normal, and enough fluid was withdrawn to reduce the pressure to 10 mm. of mercury in the lateral prone position, then, at the second examination, an increase beyond the initial reading was observed, a decompression should be done despite the fact that there may be slight signs of improvement, *e.g.*, if after four hours there has been a partial return of voluntary movement, but unconsciousness persists. I am convinced that if such a routine procedure is followed there will be very few of the so-called border-line cases.

Realizing that a universal human tendency is to ob-

ject to detail and that most of our errors could be traced to omissions on the part of the initial examiner, we have instituted the use of an examination card, outlining the essentials with sufficient space to register repeated examinations.

Importance of Accurate History.—While it is difficult and, at times, impossible to obtain an accurate history, an effort should be made to do so. On two different occasions in my recent experience a patient's life could have been saved, in all probability, had this principle been adhered to.

The following points are of prime importance:

1. To determine whether there has been a previous period of lucidity.
2. If there have been previous operations on the cranium or on parts innervated by cranial nerves.
3. If the patient has previously been subjected to epileptiform or other convulsive seizures.



FIG. 1.—Case V. L. B. Dotted line, wound from craniotomy, decompression.

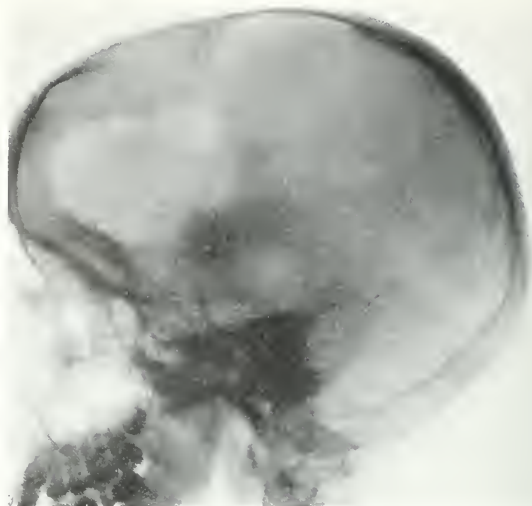


FIG. 10. Case V. E. B. Shows osteogenesis three months after autogenous transplant.



FIG. 11.—Case V. E. B. Shows osteogenesis eleven months after autogenous transplant.



FIG. 12. —Case VI, Lt. B. H. Defect before operation.



FIG. 13. Case VI, Lt. B. H. Defect after operation.

Preparation. After the head has been shaved and the scalp cleansed with green soap, alcohol and ether, it is painted with tincture of iodine. Anæsthetic: Novocaine 1 per cent. with adrenalin is used locally, unless the patient is semi-conscious, restless and difficult to restrain, when ether is substituted. If debridement is not necessary, novocaine, either alone or in conjunction with ether, is employed. One can readily see the necessity for caution in using a local anæsthetic where the tissues are devitalized and con-



FIG. 14.—Case VII, Sergeant H. Shows bone defect mid-vertex.

taminated. The needle should be introduced at least 3 cm. away from the contaminated area.

Decompression with Debridement.—The major indication for operative interference in all cases of head injury is increased intracranial pressure; the minor, the presence of devitalized and contaminated tissues. After the removal of the devitalized parts, gloves and instruments should be changed. The incision can then be extended as the condition warrants. A subtemporal decompression should be done unless there is evidence of definite localization elsewhere.

When Should the Dura be Opened?—A non-pulsating dura should always be opened if there is other evidence of increased subdural pressure, but if the lesion involves the scalp and bone with comminution and depression of the latter and the coverings of the brain are intact, or if an extradural hemorrhage

is present, the dura should not be opened unless there is a marked rise in blood-pressure and blood in the cerebrospinal fluid with marked increase in intraspinal pressure. Debridement cannot remove every vestige of infection, so one is not justified in opening the dura for exploratory purposes in its presence. The possibility of meningitis or encephalitis increases from less than five per cent. in the unopened cases to from fifteen to twenty-five per cent. in the opened ones. It is important in this connection also to remember the additional shock incident to such procedure. Where debridement has been done, primary union followed in every instance. This is a decided improve-



FIG. 45. Case VII, Sergeant H. On post-operative day 10. Note the large, dark, irregular area on the lower part of the skull, indicating the site of surgery.

ment over the technic used in pre-war days when a drain was inserted in cases of a doubtful nature. Debridement of brain tissue in this series of cases has been infrequent. Fracture of the base and vault, associated with massive cerebral contusion, frequently require prompt operative interference despite the fact that blood and cerebrospinal fluid escape from the nose or external auditory meatus or both, lessening to a limited degree the possibility of bulbar anemia.

When the scalp is intact or only moderately contused, Babcock's post-mortem coronal incision may be used to advantage. It is not much longer than the elliptical one employed in doing a subtemporal decompression and has the advantage of permitting exposure of the opposite side if the condition warrants.

Post-operative Management.—For shock an enema consisting of coffee is usually given; if the shock is profound, intravenous injection of Fischer's solution with adrenalin may be used, followed by caffeine and strychnine, hypodermatically. Mental irritability and restlessness tries the patience of the attendants and the resourcefulness of the surgeon in charge. Chloral hydrate grains xx; sodium bromide grains xl in four fluid ounces of water per rectum is at times helpful. Frequently it is necessary to resort to morphia. In forty-eight hours the dressing is changed and the alternate suture-



FIG. 16.—Case VII, Sergeant H. Defect showing active osteogenesis three months later.

removed; a boric-alcohol dressing is reapplied on the fourth and again on the sixth day, when the remaining sutures are taken out.

Treatment of Non-operative Cases.—In addition to the treatment for shock outlined above, external heat, bandaging the extremities and, at times, transfusion may be resorted to. As soon as the shock subsides the patient is placed in the Fowler position; the head is shaved and painted with tincture of iodine. There is some question regarding the proper method of treatment of the leakage of blood and cerebrospinal fluid from the ears and nose. It is sufficient to thoroughly cleanse the external parts. Probing and douching of the naris and auditory canals are entirely unnecessary. We have had no cases of meningitis develop when this treatment has been followed. The question of the duration of absolute rest in both the operative and non-operative cases is important. There is a tendency to permit mental and physical activity much too soon.



FIG. 17.—Case VII, Sergeant H. Defect before operation.



FIG. 18.—Case VII, Sergeant H. Defect after operation.

REOPERATION FOR DEFECT

Symptoms.—A period of at least three months should elapse between the first and second operation. The symptoms resulting from the defect in the skull are less severe in patients in civil than in military practice. The most important are fear of injury to the brain, vertigo, which usually occurs when the patient suddenly changes position, cephalalgia, pulsations and Jacksonian convulsions.

Pre-operative Management.—In overseas cases we studied the blood and cerebrospinal fluid cytologically and noted the blood and cerebrospinal fluid



FIG. 10. —Case VIII, Private S. Defect right frontal.

pressure before operation, in order that we might have a standard of comparison should complications arise during the immediate post-operative period. (See Case VI.) Urotropin 30 grs. in divided doses was given for several days preceding and for the first three or four days following operation. The scalp was shaved twenty-four hours prior to the operation and painted with tincture of iodine.

Anæsthesia.—I have tried novocaine with adrenalin, locally, combined local and narcotic and ether, and I believe that ether is the best anæsthetic for these cases. The removal of the external table adds exceedingly to the degree of shock, if the patient is conscious or semi-conscious. True, one may add sufficient narcotic to produce unconsciousness, but morphine and scopalamine with or without apomorphia masks shock. I have had two deaths follow

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prolonged operations on the head (not for defect) which would have been done in two stages had not the patients' real condition been masked by the narcotic, the full pulse of narcosis giving a false sense of security.

In contemplating the incision, the main points to be considered are:

1. A flap large enough to include the defect and the area of the skull from which the graft is to be removed.
2. Separation of the flap, including the cicatrix, without opening the dura. (This presupposes, of course, that there is no intracranial complication.)

The large flap makes the separation of the scar over the defect much



FIG. 29.—Case VIII, Private S. Transplant two weeks later. Note absorption of edge of defect.

easier; if the scar is unsightly, or there is any question regarding its viability, it can be removed just before the flap is sutured back in position. I know of one overseas case in which death occurred from opening the dura when the scar-tissue harbored an old infection that became active, resulting in encephalitis of quick termination. Had the two principles been adhered to, the infection, in all probability, would have resulted only in a local meningitis. I re-operated on such a case. An alien bone graft had been inserted, a local meningitis developed in three days at which time the graft was removed. The wound healed in two weeks; subsequent operation for defect was refused.

Technic.—Using a sharp knife, the pericranium is divided about 1 cm. from the edge of the defect and reflected inward, the dura is then separated from the inner table, using a blunt dural separator; the edge of the defect

is roughened with a small rongeur; a rubber drain patterned after the defect is placed over the intact area of the skull. With a sharp knife the pericranium is divided and reflected toward the centre about 1 cm.; using a chisel 1 cm. in width the pattern outline is deepened to the diploe. The utmost care is necessary in removing the graft, especially if it is large; if it is cut too thin there is danger of breaking it, or if too thick, of penetrating the inner table. On two occasions in removing large grafts, I included a small portion of the entire thickness of the skull. In each instance a small chip from the external table was placed in the opening; subsequent X-rays of these



FIG. 21.—Case VIII, Private S. Transplant four months later, osteogenesis active.

cases showed that the defects were completely filled in. Some operators remove chips from the external table and transplant them with the attached pericranium. I prefer a single graft for the following reasons:

1. It can be sutured to the pericranium and there is little danger of displacement on account of hæmatoma or accidents to the dressings.
2. Resting on the diploe it prevents to some degree an increase of extradural pressure.
3. From the patient's point of view the single plate is to be preferred because it is solid, the defect has the normal contour of the skull and the fear of injury to the exposed brain is done away with immediately.

The graft is placed over the defect and held in place by interrupted sutures of fine chromic catgut, the deep layers of the flap are closed with interrupted sutures of fine chromic. If a more rapid closure is desired, a



FIG. 22. —Case VIII, Private S. Defect before operation



FIG. 23. —Case VIII, Private S. Defect after operation

continuous deep layer of fine chromic may be used or interrupted silk-worm gut only.

In a fair proportion of these cases shock is marked, and while we have been prepared for transfusion of blood it has not been necessary, the usual treatment for shock sufficing. The patient's blood should be typed, however, and a suitable donor obtained prior to operation, in order to be prepared for any eventuality. The local treatment is the same as outlined under post-operative management. Post-operative hæmatoma has developed on two occasions. The serosanguinous fluid was removed in each case on the fourth

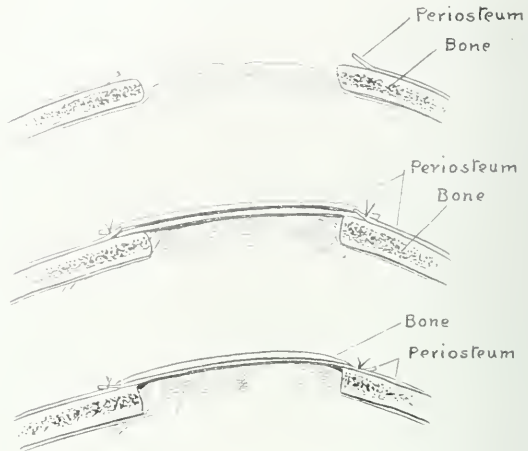


FIG. 24.—Sagittal section before and after osteoplasty.

day with a syringe and 19g needle; osteogenesis continued without interruption. The results in these cases have been satisfactory; in each instance symptoms complained of prior to operation have been entirely relieved.

This report is the result of a study of sixty-two patients with skull fracture, who were admitted to the Emergency Surgical Service of the Samaritan Hospital, Philadelphia, and at the U. S. General Hospital No. 6, Fort McPherson, Ga., during 1918 and 1919.

Of the sixty-two cases, forty-six had acute cerebral lesions associated with fracture of the cranium which were demonstrated either by X-ray, operation or post-mortem; of this number 24, or 52 per cent., were operated upon (cases of concussion and contusion not included).

Of the Operative Cases.—There were eight fractures of the vault with no deaths; sixteen fractures of the base and vault with eight deaths; six operations for defects, no deaths. Total mortality in the acute cases, 33 $\frac{1}{3}$ per cent., or of all operative cases 26.6 per cent.

Of the Twenty-two Non-operative Cases.—There were seven fractures of the vault, no deaths; fractures of the base, thirteen, two deaths; fractures of the base and vault two, two deaths; total mortality, 18 per cent.; combined mortality (operative and non-operative) in the acute cases, 26.1 per cent.

Of the acute lesions, special mention should be made of the case of massive



FIG. 25. —Case X, S. Defect fronto-parietal region left.

cerebral contusion, which on routine examination showed an increase of cerebrospinal pressure without an accompanying rise in blood-pressure (see Case Report X); Case V, Traumatic Thrombosis of Cavernous Sinus, and Case IX, Subdural Hemorrhage Associated with Cerebral Laceration.

The following cases are of sufficient interest to justify reporting:

CASE I: Illustrates the increase in blood-pressure in extradural lesions.—Private B, struck in left mid-temporal region with a piece of coal as large as two fists, thrown a distance of fifty yards. He sustained a laceration and contusion of the scalp with compound depressed fracture of temporal bone and extradural hemorrhage. He walked into operating pavilion with no evidence of increased intracranial pressure except an increase in blood-pressure (systolic 155, diastolic 85).

Treatment.—Debridement, complete closure. Small drain inserted to control hemorrhage. This was removed in twelve hours. Primary union, no complications.

CASE II: Illustrates the increase in blood and cerebrospinal pressure in moderate extradural pressure and slight cerebral contusion.—F. W., male, twenty-eight, patient thrown from motorcycle when he collided with machine, sustained compound depressed fracture right frontal region.

Examination.—Patient unconscious; no paralysis; reflexes increased; right pupil contracted; no reaction to light; left pupil dilated; reacted to light slightly; blood-pressure 150-85; pulse 84; temperature 98; cerebrospinal fluid blood-stained, pressure 7 mm. of Hg in lateral prone position; lacerations extensive over right frontal area with irregular fracture; depression involving mostly the inner table,

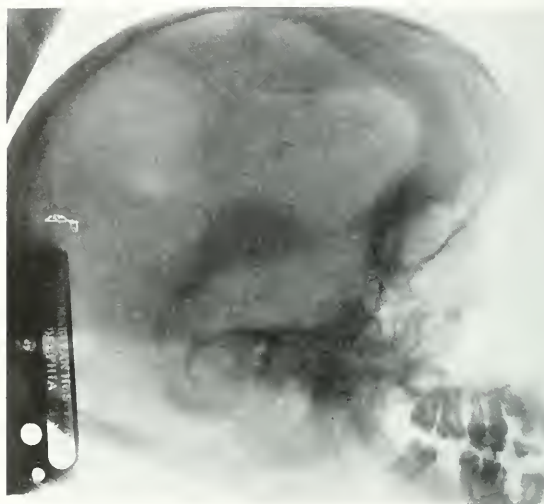


FIG. 26.—Case X, S. Rontgenogram two weeks after operation.

Operation.—Debridement, removal of bone over an area of 3 cm. in diameter; fragments re-aligned; complete closure; no complications.

CASE III: Illustrates the value of prolonged rest in massive cerebral contusion.—McC., male, struck and thrown several feet by auto, sustained a compound depressed fracture of the right frontotemporal region, with marked evidence of increased intracranial pressure. Subtemporal decompression was done.

This patient demonstrates the value of prolonged rest. When he left the hospital he thought it was a shoe factory and he was employed there. After three months of absolute rest, he recovered completely, except for slight vertigo when he changed from a recumbent to a sitting position. Patient refused operation for defect.

CASE IV: Illustrates the value of delayed debridement in profound shock.—M. S., female, age forty-six; struck and thrown twenty feet by a trolley car; she sustained lacerations and contusions of scalp; fracture of base of skull and

dislocated sacrum. She was brought to the hospital unconscious in profound shock; pulse 120; temperature 97; heart sounds very weak; B.P.S. 90; D. 60; examination showed extensive lacerations of scalp of frontotemporal regions, bleeding from ears and nose; pupils widely dilated, no reaction to light; reflexes normal; C. S. F. pressure not taken. Patient's condition considered too serious for operation. At the end of twelve hours, however, she had reacted from shock and a debridement was done; convalescence normal, wound healed primarily.

CASE V: *Unusual case of traumatic thrombosis of the cavernous sinus.*—E. B., age, twelve, male; patient struck in left orbital region by an indoor baseball. No symptoms for twenty-four hours, when he complained of left frontal cephalalgia. This gradually increased in severity. At the end of seventy-two hours he suddenly developed a convulsive seizure, general in type, lasting five



FIG. 27.—Case X, S. Defect before operation.

hours. He was unconscious forty-eight hours; no temperature, pulse 100; ocular examination showed a slight exophthalmus and subconjunctival ecchymosis of moderate degree, left eye. After seventy-two hours exophthalmus was marked. He regained consciousness on the fifth day. On the eighth day he again developed convulsions, epileptiform in character. He was sent to the hospital, temperature 98.2, pulse 120, respiration 28. Examination three hours after onset of convulsions showed patient in unconscious state, with no evidence of paralysis. Right upper and lower extremities were alternately flexed and extended, reflexes superficial and deep, increased, Babinski's questionable, cerebrospinal fluid slightly blood-stained.

Oculist's Examination.—Marked proptosis of left eyeball with tendency to deviate outward; marked swelling of the lids and chemosis of conjunctiva. Left pupil smaller than right, reactions questionable. Right eye pupil round, media clear, disc 7×8 , axis 60, veins overfilled; left fundus pathologic but details not obtainable in the room. Twenty-four hours later examination showed marked swelling of the disc. Blood-pressure systolic 188, diastolic 95. An hour after operation, 122 85.

Operation.—Left subtemporal decompression; extradural hemorrhage small in amount; dura tense, twice normal thickness, pulsation slight; cortex markedly cedematous. Patient regained consciousness within twelve hours; three days after operation a serosanguinous fluid was removed from peri-orbital tissues; reoperation for defect four months after initial operation. Patient's condition was normal except for moderate exophthalmus, one year after operation. X-ray shows that the transplant in several places had obtained the normal thickness of the skull. The oculist's report was negative.

CASE VI: *Illustrates the importance of blood and cerebrospinal pressure observations prior to and following cranioplasty.*—Lt. B. H., put his head out of



FIG. 28.—Case X, S. Defect after operation.

a car window while passing through a tunnel, was struck, sustaining a compound depressed fracture of the frontal region. He was operated upon immediately; wound had healed at the end of six weeks, leaving a defect 3 x 2 cm. close to the left frontal sinus. He complained of fear of injury to the part, and, at times, vertigo. His systolic pressure was 118, diastolic 90; cerebrospinal pressure, second lumbar interspace in the upright position was 18 mm. of Hg. He was operated on for defect three months after the wound had healed; 48 hours after operation he developed intense cephalalgia, most marked over the left frontal sinus. His pulse dropped from 72 to 50 and his blood-pressure rose to 144 systolic; diastolic remained unchanged. Ordinarily, the possibility of meningitis would be thought of, but, since there was no temperature and no marked change in the cerebrospinal pressure, the symptoms were attributed to traumatic frontal sinusitis and had entirely cleared up on the fourth day. He was discharged from the service one month after operation. Subsequent X-rays showed that osteogenesis had continued without interruption.

MANAGEMENT OF INJURIES TO THE CRANIUM

CASE VII: *Illustrating initial absorption of edges of the transplant with subsequent active osteogenesis.*—Sergeant M. E. H., received high explosive gunshot wound of the skull, shell fragments perforating helmet. A debridement and decompression were done immediately. The wound healed within three weeks; ten months later he was operated upon for defect. External table with attached pericranium was used to fill in defect. The roentgenographs show initial absorption of the transplant with subsequent active osteogenesis.

CASE VIII: *Showing that the pericranium can be apposed to the dura without interfering with osteogenesis.*—Private J. S., while driving motorcycle near Coblenz collided with an automobile and sustained fracture compound comminuted

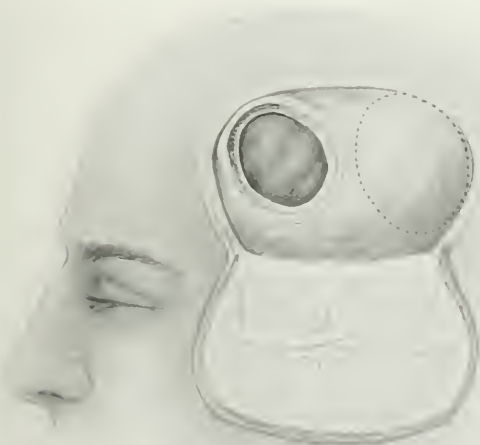


FIG. 29.—Case X, S. Large flap in making defect. Pericranium apposed toward the centre of the defect; dura separated from outer table of calvarium. A centimetre, edge of defect roughened with rongeur.

of the right frontal region with a linear fracture radiating from depression in to right orbit. A debridement and decompression were immediately done and the wound healed in two weeks. On examination ten months later he complained of vertigo, tingling sensation on extensor and flexor surfaces of both forearms, dimness of vision and cephalalgia, all of which had persisted since his first operation. He was very restless and depressed. In this instance the graft had a tendency to curl and when placed in the defect the normal contour of the skull was maintained, the pericranial side of the graft being apposed to the dura. Patient was immediately relieved of all symptoms and subsequent X-ray showed that osteogenesis continued without interruption.

CASE IX: *Illustrates marked increase of cerebrospinal pressure due to subdural hemorrhage with only moderate increase in blood pressure.*—G. W. K., male, age sixty nine, was admitted to the Samaritan Hospital with a history of having fallen down a flight of stairs three hours before. He was unconscious, respira-

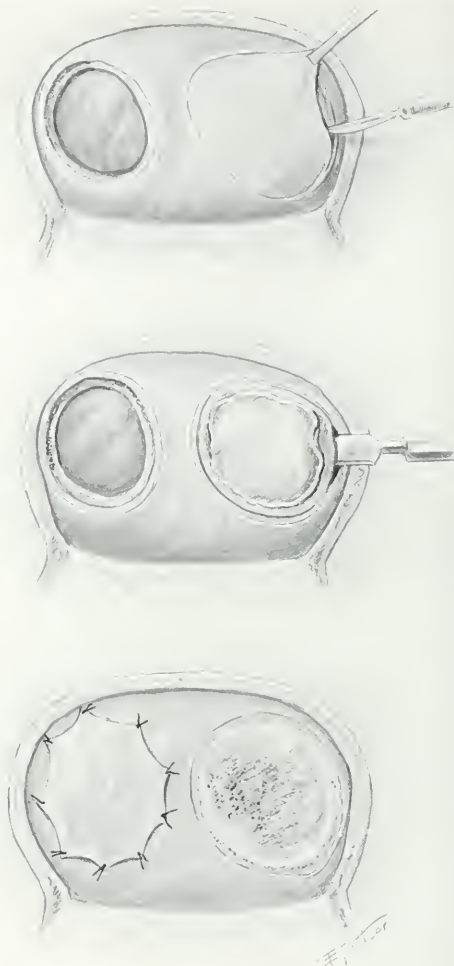


FIG. 30.—Case X, S. Separation and reflection of pericranium for a distance of one centimetre. Removal of external table with attached pericranium. Transplant in place.

MANAGEMENT OF INJURIES TO THE CRANIUM

tions Cheyne-Stokes in character, pupils dilated and fixed, pulse 52, blood-pressure, systolic 140, diastolic 65; no involvement of cranial nerves. There was a partial paralysis of the muscles of the left lower extremity; reflexes were negative except slight exaggeration of patellar right and diminished left. A hematoma beneath the occipitalis was present; there was no bleeding from the auditory meatus; the cerebrospinal pressure in the lateral prone position in the first lumbar interspace, was 30 mm. of mercury; the fluid was deeply blood-stained, and on the withdrawal of 3 c.c. the respirations which had practically ceased were immediately resumed. A right subtemporal decompression was immediately decided upon; before the bone could be removed the patient stopped breathing, artificial respiration was resorted to and the first voluntary respiratory effort occurred twenty minutes later, during which time an area of bone 8 cm. in diameter had been removed and about 250 c.c. of blood clot and free blood were removed. Examination of the cranium showed that the inner table of the right frontal was depressed, a portion projecting into the right middle and inferior frontal convolutions for a distance of 1.5 cm.; about two drachms of pulpified cerebral substance came away with the washings. (Using normal saline with the aid of a No. 14 F. catheter the cranium was washed free of debris.) Bleeding was controlled by placing a gauze strip against a rent in the superior petrosal sinus and the wound was closed. The patient left the operating room in good condition; respirations were 22, pulse 88. He reacted well for the first ten hours, then his temperature began to rise, reaching 105.3 sixteen hours after operation, when he succumbed. The respirations were of the Cheyne-Stokes type for four hours prior to death.

CASE X: Illustrates the importance of a definite routine in the management of cranial injuries, especially repeated observations of cerebrospinal pressure.—S., male, age twenty-nine, brought to the Samaritan Hospital with a history of having been thrown from motorcycle, striking left frontotemporal region.

Examination.—Patient unconscious, respiration 20, shallow; pulse 82, volume fair; pupils dilated; reaction slight; paralysis of left upper and lower extremities; deep reflexes absent on left, increased on right side; blood-pressure systolic 100, diastolic 55 mm. of mercury; lumbar puncture showed cerebrospinal fluid to be blood-stained; pressure in the lateral prone position, second lumbar interspace, 22 mm. of mercury. Wound in temporoparietal region ragged, 4 cm. in length with probable depression of temporal bone. Patient placed in Fowler position, head shaved; painted with tincture of iodine and antiseptic dressing applied. Three hours later ophthalmoscopic examination showed right eye, media clear, disc almost obliterated, veins overfilled, arteries small, entire retina, especially portion surrounding disc, oedematous; left eye apparently normal; blood-pressure systolic 112, diastolic 68; cerebrospinal pressure 28 mm. of mercury in the lateral prone position.

Operation.—(Seven hours after admission) Debridement, left subtemporal decompression; depressed fracture frontal bone moderate; no pulsation of dura; ascending frontal and ascending parietal convolutions hemorrhagic and oedematous. Patient regained consciousness six hour later, wound healed normally; blood-pressure after decompression, systolic 92, diastolic 58; prior to discharge from hospital four weeks later, systolic 118, diastolic 70, cerebrospinal pressure in the lateral prone position 5 mm. of mercury. Operation for defect four months later.

SUMMARY

1. In injuries to the cranium or its contents, lumbar puncture with spinal fluid pressure observations are essential to proper management.

2. In certain cases, withdrawal of fluid may so reduce intracranial pressure that operation may be avoided; in borderline cases it is a means of determining

early the least degree of intracranial tension; blood-pressure reading at definite intervals may accomplish this in part, but one may have an increase in intracranial pressure and no corresponding increase in blood-pressure.

3. Cerebrospinal pressure observations are important before and after plastic operations on the skull.

4. Finally, repeated examinations of the spinal fluid for microscopic blood are of importance in differentiating the less severe types of cerebral trauma.

I am indebted to Dr. W. W. Babcock, Chief of the Surgical Service at the Samaritan Hospital, for the privilege of operating on a number of the cases reported, and to my colleagues, Drs. John Leedom and G. Mason Astley, for the privilege of studying the operative and non-operative cases on their respective services.

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CANCER OF THE TONGUE

By PHILEMON E. TRUESDALE, M.D.

OF FALL RIVER, MASS.

FOUR cases of cancer of the tongue were admitted to our hospital at short intervals during the summer of 1919. This group of cases, though small, provides a picture of the disease which demonstrates how speedily cancer in this region may become a menace to life.

From the duration of the disease and the results, the four cases may be considered in the following order:

CASE I (4652).—Female, age seventy, had noticed an ulcerating area on her tongue three years before presenting herself for treatment. On account of the advanced stage of the disease no operation was done. She lived eight months. This case is recorded as evidence of the slow progress of cancer in the aged. At seventy years this patient lived more than twice as long as the average of unoperated cases.

CASE II (4753).—Male, age forty-nine, had noticed the growth nine months before coming to the hospital. Origin apparently unprovoked. He lived ten months after operation.

CASE III (4631).—Male, age forty-seven, first observed a hard ulcerated area on the margin of the tongue seven months before operation. Origin ascribed to rough edge of tooth. He lived sixteen months after operation.

CASE IV (4730).—Male, age fifty-one, was operated upon four months after growth appeared. Growth began following a sore caused by the cutting edge of a molar tooth. Referred for operation by his dentist. He is still living without recurrence three and one-half years after operation.

The lesson to be learned from a study of this comparatively small group of cases is that cancer of the tongue, except in the aged, grows rapidly, invades the lymphatics early, and becomes hopelessly advanced in from six to nine months. The fatal pinch is seen too often as the result of ignoring a small sore for weeks or months. While this is true of cancer invading any organ it is particularly so when the malignant process develops in a moist actively functioning tissue such as the buccal mucosa.

In a review of the literature we find that cancer of the tongue, usually in the form of epithelioma, is found to be on the increase. As compared in frequency with cancer invading other regions of the body, as the stomach, breast, rectum, uterus, etc., it stands about fifth. Mr. Barker (Barker's System of Surgery, vol. ii, p. 578), of London, has reported a series of tables showing that during a period of thirty years, cancer of the tongue increased from 2.6 per cent. to 11.5 per cent.

Initial Stage.—Although the medical profession and laity have not been aroused to the importance of excision of cancer of the tongue when it first appears in the form of a wart, fissure or superficial tubercle, cases are operated upon now in early mid-period of development more frequently than in former years. Butlin (British Medical Journal, January 2, 1909) describes five con-

ditions which appear on the tongue that are ear-marks of cancer: "(1) A little plaque-like hard sore, smooth and polished, neither ulcerated nor eroded. (2) The transformation or replacement of a simple ulcer by feeling a little stiffer and a very little firmer. (3) The transformation of an entire plaque of leukoplakia into a plaque of cancer. The difference is marked by a very slight thickening, a denser white, and furrowing in various directions, but without excoriation or ulceration. (4) The transformation of one small area of a leukoplakia tongue into cancer, only marked at first by a very slight and superficial hardening. (5) A white, warty growth or compound wart, neither broken nor ulcerated and feeling at first as if it were fixed to the mucous membrane and quite superficial."

Perhaps in many instances such manifestations would fail to reveal cancer tissue, and would come under a classification of "pre-cancerous" lesions. One is animated nevertheless, to contrast the end result of excision of a new growth in the above stage with the altogether too frequent necessity of a sweeping operation required to remove cancer-invaded lymphatic nodes in the region between the floor of the mouth and the clavicle. A campaign of education and enlightenment of the public and the medical profession, such as the American Society for the Control of Cancer has been conducting, is opening the door of hope in this direction.

Mid-period of the Disease.—A mid-period in the life of cancer of the tongue has been described by Blair (Blair, *Surgery of the Mouth and Jaws*, p. 556). He considers it starts when the objective symptoms render the diagnosis rather obvious.

This is a most important period, because during it the growth passes from the operable to the inoperable and hopeless stage. It may be assumed that during the initial stage the patient has been trying home remedies without success. Then the chronicity of the sore prompts him to consult a physician. Here opportunity is given for diagnosis with the aid of the microscope and attacking the disease in the early mid-period. If the diagnosis is not promptly established further loss of time adds greatly to the risk of incurability. It is well to remember that squamous epithelioma once started does not recede. If the patient is lucky the lesion of the tongue may clear up somewhat under specific treatment but cell division of the cancer continues. Accuracy in diagnosis then is essential and time is of such pressing importance that therapeutic tests should yield to the more expeditious and precise methods of microscopical examination of tissue.

We note the expressions of Warren and Butlin upon the vital importance of early diagnosis. "Owing to the appalling danger," wrote Warren, "there are few diseases in which early diagnosis is more essential than in cancer of the mouth. To give the patient 'a chance' is, under such circumstances, to give the cancer a chance to form an irresistible hold, and to take away all hope of complete recovery from the patient."

Symptoms.—The cardinal symptoms of this mid-period as it progresses are ulceration, pain, hemorrhage, salivation, lymphatic infection, anemia, and loss of weight. The ulcerated area may have a smooth red surface, but usually it is ragged, foul, and covered with necrotic tissue which bleeds easily. Again Blair (Blair, *Surgery of the Mouth and Jaws*, p. 558) calls attention to the appearance of the edges of the growth which are rolled and prominent, seldom punched and almost never undermined.

Pain is an early symptom. It is not local but referred to the region of the ear and side of the head. Case No. 4630 complained of intense hemicrania. The pain was almost continuous, causing insomnia and interference with deglutition.

Hemorrhage occurs whenever the surface is excoriated or impinged upon by carious teeth or particles of unmaasticated food. Except in the later stages, bleeding is rarely of an alarming nature.

Salivation, in some degrees, is constant and troublesome from the beginning.

Cancer of the tongue, even in the initial stages, must be a local process for a period of some length. Lymphatic infection, however, has begun in too many cases before the diagnosis is established. The assumption that glandular infection does not exist because nodes are not felt is proven erroneous repeatedly when the superficial layers of the neck are laid open. In the most rapidly progressive cases the glands may be infected within a few weeks after the disease within the mouth has become actually carcinomatous. On the other hand, in rare cases there is good reason to believe that carcinoma of the tongue may exist six months or longer before the glands are involved. However, Jacobson (Jacobson and Stewart, *Operation of Surgery*, p. 445), of Guy's Hospital, reminds his readers that epithelioma of the tongue, usually thought a slow cancer, here in a moist, warm cavity, much irritated and never dry, is terribly rapid; that gland invasion is not only certain but inevitably early as well.

One may expect to find the first invaded gland in the region of the neck corresponding to the direction of the lymph channels draining the area of the tongue which is invaded. If the lesion involves the tip of the tongue, careful palpation should be made for enlargement of the glands in the submental and sublingual groups. Cancer of the border of the tongue drains into the submaxillary gland and the surrounding lymphatic glands. One vessel runs from the neighborhood of the frenum to the deep cervical glands lying near the bifurcation of the common carotid. When the lesion involves the base of the tongue, metastasis takes place in the superior deep cervical lymphatics. These drain all parts of the mouth, fauces and upper part of the pharynx.

In moderately advanced cases of carcinoma in any region of the tongue or floor of the mouth, any or all cervical lymphatic gland groups may be found to be involved.

Anemia and loss of weight are not conspicuous symptoms in the early stage

of cancer of the tongue. The patient may remain well nourished and show only slight evidences of change in blood picture until the lesion of the tongue has become sufficiently advanced to interfere with the appetite and deglutition, or until invasion of the lymphatic system has become well established.

Prognosis.—The outlook in any case depends primarily upon the age of the patient, the stage of the disease, and the method adopted for its treatment. Among patients under forty years of age, cancer of the tongue does not present a hopeful picture unless detected in its initial stage and eradicated by intrabuccal and cervical operations combined. The average duration of life of any unoperated patient is less than two years. If not treated surgically, cancer in this region invariably progresses to a fatal termination, death coming from poisoning, starvation, and exhaustion.

Of 172 cases of cancer of the tongue and mouth at the Massachusetts General Hospital, reported by Warren (J. C. Warren, Report of Cancer of the Mouth and Tongue, before Second Congress of the International Surgical Society, September, 1908), 29 per cent. were found to be inoperable. And it is doubtful if this percentage of inoperable cases has been reduced materially up to the present day.

At that time Warren placed the percentage of cures after operation at 17.5 per cent.

Butlin (Butlin, British Medical Journal, January 2, 1909) reported an operative mortality of 10 per cent. and 33.9 per cent. cures.

In general it may be said that treated surgically in the initial stage or in the early mid-period of the disease, the present day mortality from operation is not above 5 per cent., proportion of three-year cures at least 30 per cent. Passing through the mid-period we frequently find the floor of the mouth invaded and the operative mortality increased rapidly while the percentage of cures falls off abruptly. Life is seldom prolonged by secondary operations.

Treatment.—The treatment of cancer of the tongue is surgical whenever the disease is found to be in the operable stage. The value of X-rays and radium as therapeutic measures is still open to discussion. The former is used as an adjuvant to surgery after the cancer-bearing tissues have been removed by careful dissection. Radium in our experience is too often found disappointing to be employed in other than the inoperable and recurring forms of the disease. The tendency for patients to seek surgical treatment last instead of first is responsible for many sad pictures of incurability.

The best known methods of operation have been described by Judd, Greenough, Whitehead, Kocher, Butlin, Crile, Von Bergmann, Poirier, Bloodgood, and Blair. The contributions of Butlin and Warren marked an epoch in the surgical treatment in that they established the principles upon which the present technic is carried out. This was based upon an intimate knowledge of the cervical lymphatic centres draining the tongue and the floor of the mouth. From their writings it was made clear that a knowledge of the

distribution of the cervical lymphatic centres draining the tongue was of paramount importance to the surgeon in his attack upon cancer in this region. Warren showed that anatomically the base of the tongue was separate from the body of that organ; that the lymphatic system of these two areas was quite distinct. He also indicated that the lymphatic system of the two divisions of the tongue was separate. Thus, it is feasible to leave the base of the tongue when the site of the cancer involves the body and to remove one-half of the tongue when only one margin has been invaded by new growth.

Kocher's operation in all cases moderately advanced, consists in dividing the jaw in the mid-line and thus widening the field of operation within the mouth in order to attack the disease at the base of the tongue and on the walls of the pharynx. Recurrences after operation are seen frequently in the floor of the mouth so that a common failure in the operative technic is to leave cancer tissue at this level. The Kocher operation, although associated with an increased operative mortality, gives a wide exposure of the base of the tongue, floor of the mouth and pharynx, thus affording the best opportunity for complete eradication of the disease. Considerable discussion has centred around the advisability of doing the neck dissection and intraoral operation in one stage or two. Rules are not applicable. It is more desirable to do both during the same operation, and this is the usual method now in practice. However, patients vary much as operative risks, and surgeons vary considerably in skill and practice, so the decision to make the operation a one stage or two stage procedure must remain always a test of surgical judgment. The necessity of carrying out a complete dissection of the lymphatic vessels and the lymphatic glands in any case is no longer disputed. Whenever this major part of the operation is omitted the surgeon leaves his patient with a well recognized danger of recurrence.

The Cautery for the Purpose of Dissection.—We are aware that many surgeons are loath to use the cautery knife in the dissection of a cancer-invaded field. While the method is still open to inquiry we have employed it on account of its obvious advantages. In our operations thus far we have carried out the neck dissection from the floor of the mouth down to the level of the cricoid cartilage, removing one or both submaxillary glands and all lymphatic vessels and nodes of both sides of the neck. With knife dissection this is a time-consuming operation. About half the period is occupied in clamping and ligating small blood-vessels. The loss of blood is usually slight, but on occasion it may be considerable. It is common knowledge that cancer patients are affected more unfavorably by hemorrhage than other individuals. It is also a known fact that cancer is a blood-destroying disease, anemia being one of the familiar symptoms. Therefore, while it is important to conserve the blood volume during operations in general, there is a particular reason for doing so when the operation is for cancer. In consequence of this recognized necessity for saving time and blood volume in carrying out the complete operation for cancer of the tongue we continue to employ the cautery knife as an

instrument for dissecting out the lymphatics of the neck. The method has shortened the time of operation approximately one-half.

Operation.—If oral hygiene has been neglected, as it usually is in these cases, a few days will be required for preparatory treatment by the frequent

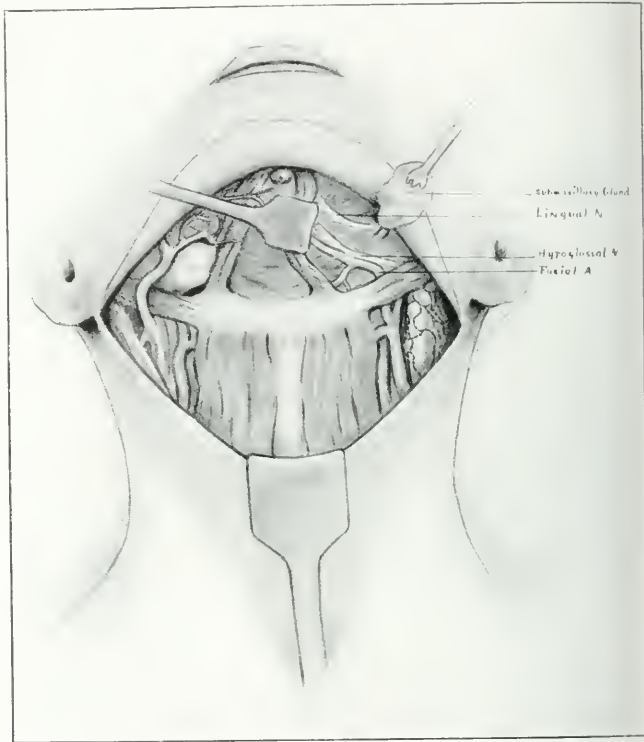


FIG. 1.—Shows the lingual nerve passing adjacent to the deep part of the submaxillary gland, and the hypoglossal nerve and facial artery in relation to the deeper structures of the neck.

use of mild alkaline and styptic mouth washes. With the patient in a semi-upright position, ether is administered by the intrapharyngeal method. The field of operation is prepared with iodine, half strength solution being used in the mouth. The neck dissection is done first. A transverse incision, slightly curved downward, is made from a point about 2 cm. below the lobe of the left ear to a corresponding point below the right ear. The knife is used in making the incision through the skin and dissecting back the flap. Then with the

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cautery knife, the lymphatic gland-bearing area is dissected *en masse* from the entire cervical region thus exposed. In removing the submaxillary gland on the healthy side care must be taken to preserve the hypoglossal nerve and the lingual nerve (Fig. 1), between which passes the duct of the gland. A small branch of the facial nerve supplying the angulæ oris, which depresses



FIG. 2.—Case IV. Extent of cancerous growth invading the margin of the tongue.

the angle of the mouth, is frequently injured in dissection close to the ramus of the jaw. This nerve is superficial and very small, but important because, if severed, it causes drooping at the angle of the lower lip. Perforation of the floor of the mouth is occasionally unavoidable when the operation is done in one stage. This invariably complicates recovery by a disagreeable infection.

On completing the dissection the skin margins are brought together and a rubber tissue drainage is placed in either side of the neck.

The second part of the operation follows and consists in removing a part

or whole of the tongue. In the three cases herewith reported this step was carried out in the following manner:

The tongue was drawn forward on a retention suture passed through the tip. The mucous membrane on the floor of the mouth was then incised and dissected free, the line of separation being fully 1 cm. distant from the growth. The lingual artery, standing out somewhat like a cord, was next exposed by blunt dissection and tied. The body of the tongue was then divided along the raphé, care being exercised to have the line of division extending wide of the growth (Fig. 2). The diseased half was drawn upward and removed by cutting the geniohyoglossus muscle and meeting the mid-line incision by a curved section at the root of the tongue. In Cases III and IV, the disease was limited to the margin of the tongue. In Case II, however, the edge of the carcinoma involved the floor of the mouth and in removing the structures here a communication was made with the neck. This was difficult to close, and complete union did not result. The secretions of the mouth drained into the neck with infection as an inevitable consequence. A sizable rubber tissue drain had been placed in the neck wound and a bad infection thus averted.

In our cases, speech faculty with lingual phonetics returned, so that oral communication was established in from seven to ten days after operation. For several weeks after operation the remaining half of the tongue did not come in contact readily with the soft palate, hence the linguals, d, k, t and q were pronounced with difficulty. In one case the motor function of the tongue was so interfered with that for nearly two months the patient was unable to place morsels of food between the teeth. He frequently aided mastication by using his fingers for this purpose, as on the first occasion when he reported that he had "lost a piece of candy" in his mouth. At the end of six months all of these patients had good function of the tongue, with only a slight lisp and no embarrassment during mastication.

NOTE ON THE PATHOLOGY AND SURGICAL TREATMENT OF LEUKOKERATOSIS LINGUÆ

BY CHARLES GREENE CUMSTON, M.D.

OF GENEVA, SWITZERLAND

LEUKOKERATOSIS of the tongue and buccal cavity is not exclusively the consequence of syphilitic infection, because both diabetes mellitus and the arthritic diathesis frequently offer a favorable soil for the development of this morbid process, being in fact general predisposing causes. But the determining factor must be some type of local chronic irritation of the mucosa, particularly tobacco. Women are rarely afflicted. Out of a total of 848 cases collected from the literature, including 10 of my own, there were only 30 females.

The normal histology of the mucosæ comprises a stratum germinativum, or layer of basal cells, and secondly, a stratum filamentosum, or layer of polyhedric cells united by cellular filaments. The mucosæ do not normally contain eleidin and instead of a stratum granulosum there is a uniform layer of flattened and very imperfectly keratinized cells, containing a flat nucleus. On account of the absence of a horny layer and eleidin the mucosæ are transparent, while their rosy tint is due to the richly vascularized subjacent dermal papillæ.

In leukokeratosis of the mucous membranes eleidin is present and a horny layer exists, hence the white, pearly and opaque aspect of the patches. Consequently leukokeratosis is simply an epidermization of the mucosa but with an exaggeration of the characters of the epidermis. Otherwise put, it is a hyperkeratosis.

Histologically, leukokeratosis consists of two fundamental lesions, *viz.*, *hyperkeratinization of the mucosa* and *sclerosis of the derma*.

Lesions of the Mucosa.—The superficial horny layer of epithelium is very thick. One may distinguish an upper stratum composed of nucleated cells, staining with picric acid, and a lower stratum taking on a pink tint due to the large amount of diffused eleidin present. Eleidin is seen as minute particles disseminated in the cell protoplasm and above all in the shape of an inter-cellular network. Eleidin abundantly distributed throughout a tissue from which normally it is absent results in the formation of a normal epidermis or even hyperkeratinization of the mucosa.

A stratum granulosum develops—which normally is absent in the mucosæ—and may even reach a state of development much greater than in the normal epidermis. It contains cells whose protoplasm is laden with eleidin and surrounded by it. The cells are arranged in three or four superimposed layers, while at the level of the interstices of the papillæ there may be six or seven layers. Stained with picro-carmin these layers are seen as a bright red undulating band, the undulations representing its thick-

ness, and it would seem as if the mucous epithelium had undergone a kind of cutization.

Perrin has pointed out that this classic aspect is not always found; the diseased epithelium may simulate normal epidermis or present an irregular structure. The eleidin layer may be wanting at certain spots, the horny strata at others. Such atypical aspects may be due to the irregular evolution or long duration of the process.

Some observers maintain that Malpighi's layer is atrophied. The cells are flattened, stain badly, becoming progressively more shrunken and fatty as the free surface is approached. On the contrary, the interpapillary prolongations in the deeper parts are hypertrophied. These changes are the result of irritation of the cells by inflammatory lesions arising in the derma of the mucosa, which allows toxins to filtrate through the epidermis. The cloudiness of the cells indicates functional hyperactivity and explains the white aspect of the leukokeratotic patch which, according to Milian, is not due to the presence of a horny layer or to the stratum granulosum.

Lesions of the Derma.—The derma or mucous chorion is more or less extensively sclerosed, and is two or three times thicker than normally. In recent lesions there is an infiltration of young cells in the superficial layers and apex of the papillae, especially around the vessels, which appear to be the starting-point of the pathological changes.

The vessels are at first dilated, then compressed and atrophied by the sclerotic tissue which invades their adventitia, hence loss of nutrition resulting in dekeratinization as a consequence. This dekeratinization is the cause of the small ulcers met with on the surface of the patches and may be regarded as true trophic disturbances. The muscle fibres are likewise involved in the sclerous process, becoming dissociated and atrophied.

The sclerous process extends quite a little beyond the surface of the patch and clinically it will frequently be noted that the patch rests upon a smooth, sclerous surface, indurated to the feel and devoid of papillae extending outside the limits of the leukokeratotic lesion.

An accumulation of embryonal elements around the submucous glands may be found as well as an endothelial proliferation of the glands themselves, their functional disturbances being thus accounted for. In mild or recent cases, when the process is slow and torpid, the papillae of the derma keep their shape and may undergo hypertrophy. If, on the contrary, the patch assumes a rapid evolution with sharp reactions, the papillae disappear in the surrounding cell proliferation.

According to Gaucher, a papillomatosis at least exists histologically in the patches and is the starting-point of malignant transformation.

Sclerosis of the derma varies in intensity and often stands out in contrast with the thinness of the epithelial patch. It is hardly ever wanting and it even appears to precede the hyperkeratosis and is especially intense in leukokeratosis of luetic origin, being in these circumstances accompanied by occluding endarteritis. Now, as syphilis is a particularly sclerogenous process, the

sclerosis of the derma often precedes the epithelial hyperplasia, hence in syphilitic subjects the latter may be dependent upon two factors of irritation, *viz.*, a deep inflammatory one—sclerosis of the derma—and an external one realized by irritants and trauma of the mucosa. Thus the frequency of leukokeratosis in luetic subjects.

Like cutaneous papillomata, leukokeratosis may end in malignant transformation if the subject lives long enough. In reality, cancer is not a primary morbid process as it develops in a soil that has previously been altered by preëxisting tissue changes; it is the ultimate outcome of multiple preparatory, pathologic conditions. In the case under consideration the leukokeratosis is the preparatory condition; and as Menetrier well puts it, "Cancer is a cell proliferation belonging as such to all morbid conditions in which the normal function of cell multiplication has become involved." Hence leukokeratosis and cancer are merely two different phases of the same process, the former being the prelude to the latter.

In histologic specimens of long standing fissured patches of leukokeratosis, clinically doubtful, Lenoir has described two precursory signs of malignant change, *viz.*, (1) proliferation and changes of the cells of Malpighi's layer indicating an inflammatory process of the epidermis, and (2) granulo-fatty or colloid degeneration of these cells, with interposition of migratory cells and cell infiltration sometimes extending to the papillæ of the derma.

When epidermic globes are present cancer has fully developed, but before these appear there is an embryonal cell infiltration of the deep epithelial layers and an increase in size of the entire epithelial layer, as well as an increase in size of each of its component elements in particular. Such are the various characters that are to be searched for when a biopsy is done.

The indications for treatment of leukokeratosis are to be found in the nature of the lesion present and their pathology, the principal aim of the surgeon being to prevent cancerous evolution. In this, one is to be guided by the age, situation, aspect, extent and number of the patches. Unquestionably, a patch which has recently developed may at first be treated by medical measures, but if the patch is of long standing and offers suspicious characters surgical removal should not be delayed.

The clinical aspects of the patch are also to be considered. If the patch is distinctly defined and opalescent, lying on healthy mucosa without induration or pain, many local medical treatments may be essayed, but even if the patient is distinctly syphilitic with a positive Wassermann, our limited experience has led us to be very pessimistic as to any curative effects from even an intensive treatment with the arsenical preparations and Hg. The following case is illustrative:

A male, *æt.* thirty-six years, developed a patch of leukokeratosis on the left side of the dorsum of the tongue, measuring one centimetre in length by six millimetres broad, nineteen months following the initial lesion, therefore in the height of the secondary phase. This patch had developed in the centre

of a mucous patch. An intensive treatment with 914 (total amount injected in nine weeks = 5 grammes) and thirty intravenous injections of 11g cyanide had no effect on the leukokeratosis, while, strange to relate, as the mucous patch retrogressed the leukokeratotic patch became more manifest. For this reason, the lesion being localized and single, it was removed by free excision carried down to the muscle of the tongue.

The patient, a heavy smoker, was ordered to give up the use of tobacco in any form, which he did, and when seen three years after the excision no recurrence had taken place.

If, on the other hand, the patch is thick, squamous, ulcerated or painful, its removal should be at once undertaken. The extent and number of patches must also enter into consideration, because it is certain that the greater the extent the greater the probability of malignant change. It is also true that when once malignant transformation has ensued, it is relatively benign, and many surgeons have referred to the slow evolution. Nevertheless, this does not imply that time should be lost before complete surgical removal is resorted to.

When the patch is not too large and is single, free excision down to the muscle of the tongue is all that is required, but when there are several patches or when a considerable portion of the dorsum of the tongue is involved, then, to our mind, decortication is the only logical procedure, the following technic being the most satisfactory:

Regional anaesthesia is obtained by a perineural injection along the two lingual nerves with a 1 per cent. solution of novocaine to every 100 c.c., of which 10 drops of a 1:1000 solution of adrenalin are added.

Two silk anchor threads are passed transversally through the tongue not far from the tip and two others are passed at the base of the organ, one on the right, the other on the left of the lingual V. By traction on these anchor threads the tongue is completely extruded and held in position, clearly exposing the field of operation.

Two incisions are then made starting from the anterior extremities of the lingual V and are made to converge towards the median line *above* the lesions. By their union these incisions form a V with the apex pointing forward which circumscribes the healthy area of the dorsum of the tongue. A V-shaped incision is now made following the edge of the tongue. This marginal incision is carried backwards on both sides of the tongue until it joins the posterior ends of the first two incisions. The entire area comprised between the central V and the marginal U incisions must next be removed by decortication.

The mucosa is firmly caught with forceps and rapidly dissected off with scissors from the subjacent muscle with great ease. Bleeding is profuse but easily controlled.

On account of the great pliancy of the carneous body of the tongue all that is necessary is to suture the edges of the central mucous triangle to the external edge of the wound and further down to bring into approximation

the edges of the tongue, thus rolling over the edges towards each other. When the sutures are completed the tongue presents an ungainly cylindro-conical shape and during the first few days following the interference there is some lingual tumefaction and a small submucous blood collection in the floor of the mouth, but within a week this hæmatoma will have disappeared.

In my ten cases primary union was effected in all, and after several weeks or months the tongue had become flattened out and assumed an almost normal shape. Naturally, the mucosa of the under surface of the organ being stretched, it covers the decorticated area, so that the latter will offer a smooth mucosa deprived of papillæ. The ranine veins are likewise drawn upwards and are to be seen on the edges of the tongue.

Mastication and deglutition become normal but gustation remains somewhat obtuse. Speech generally becomes quite perfect, although in two cases the patients continued to lisp.

LEUCOPLAKIA BUCCALIS

By HENRY PELOUZE DE FOREST, M.D.

OF NEW YORK, N. Y.

THE first time that the existence of this rare condition was brought to the notice of the writer was in 1898, when he was called upon to review, "The Atlas of Syphilis and Venereal Diseases," by Franz Mracek.¹ In this Atlas, the following case was reported:

CASE I.—*Leucoplakia buccalis, involving the hard palate, showing elevated, coalescent papules* (Fig. 2). R. S., twenty-one years old, prostitute, admitted November 10, 1896. The patient was first infected in 1893, and has since been treated nine times for syphilis. Most of the relapses consisted in papular eruptions on the genitals. The present attack first attracted the patient's notice two weeks ago.

On the hard palate, stretching from the fossa behind the incisors to the soft palate, is a coalescent group of mulberry-like proliferations of hard, yet elastic consistence, somewhat lighter in color than the slightly inflamed mucous membrane of the surrounding parts. The edges of the soft palate and uvula are slightly thickened and distorted as the result of a former attack of the disease, which even now betrays itself by an infiltration on the edge of the soft palate and uvula. The vibrations of the pillars of the fauces during phonation are sluggish and irregular. Concomitant symptoms are found in flat, glistening papules, as large as a bean, on the labia majora, and in a general glandular enlargement.

Treatment.—Inunctions. The specific infiltrations disappeared, the proliferations on the hard palate subsided, and the mobility of the pillars became almost normal.

In this particular case there was a definite history of syphilis, and the writer believed from the context that leucoplakia buccalis was really a syphilitic lesion appearing in the mouth in relatively rare instances.

Several years passed before another published case attracted the attention of the writer. This also was reported by a German authority,² and was summarized as follows:

CASE II.—*Leucoplakia buccalis, involving the tongue. Associated with ulcerating papules* (Fig. 3). P. P., forty-nine years old. Has been treated as an outpatient. The patient says that four years ago she noticed fiery-red, isolated nodules in the tongue for the first time. Various remedies were tried, among them cauterization (with lunar caustic), which caused the nodules to disappear for a time, but they always recurred. A year ago they again appeared, and the patient underwent twenty inunctions, whereupon the eruption subsided. Two months ago the nodules began to develop again, and with them whitish, coalescent ulcers.

Present Condition.—The tongue is only slightly swollen; at the back the papillae are still intact; the front is smooth and covered for the most part with a cloudy, whitish layer of epithelium. A discolored, slightly raised ulcer extends

¹Atlas of Syphilis and the Venereal Diseases, by Franz Mracek, of Vienna. W. B. Saunders, Philadelphia, 1898. Fig. 42-A, 1344-3819.

²Atlas of Syphilis and the Venereal Diseases, by Franz Mracek, of Vienna. W. B. Saunders, Philadelphia, 1898. Fig. 41-B, 1343-3818.

across the tongue and along both margins, while a similar ulcer, as large as a pea, occupies the tip of the tongue a little to the left of the centre. The ulcers are slightly raised above the surface and surrounded by a sharply defined inflammatory border.

The submaxillary glands are hard and moderately swollen. Painful mastication.

After the patient had been treated for eight days, scar-formation began in the middle of the ulcer, which finally was converted into a whitish, epithelial hyperplasia.

In this case, also, there was a distinct history of syphilis, and in this case the syphilitic lesions of the mouth overshadowed the leucoplakia patches.

About the same time, in 1903, the following case was also noted:³

Case III.—*Leucoplakia (Psoriasis) Linguae* (Fig. 4). C. J., forty-nine years old. Under treatment for emphysema and pulmonary catarrh.

The patient has had various diseases. In 1872, he acquired a hard chancre, which was followed by eruptions on the skin and sores in the mouth. With the exception of local remedies and river baths the patient did not undergo any treatment for his disease. Lunar caustic, gargles, and precipitate ointments were the local remedies he employed.

The patient was formerly a heavy smoker; he worked on a freight tram and smoked a cigar, or a pipe, day and night. In 1891, he noticed for the first time whitish vesicles on the tongue, which bled when they were opened with a pin. The present condition of the tongue the patient says he has noticed for the last eighteen months. He is thin, but not cachectic.

Present Condition.—The tongue is not perceptibly swollen, but the patient can only protrude it a little and with difficulty. The surface is white, moderately thickened, and divided into irregular islands by shallow grooves. These grooves do not appear to be due to contracting scars, but rather to correspond to the normal furrows in the tongue. On the other hand, the islands appear slightly raised, owing to the thickening of the epithelium and to the moderate inflammation

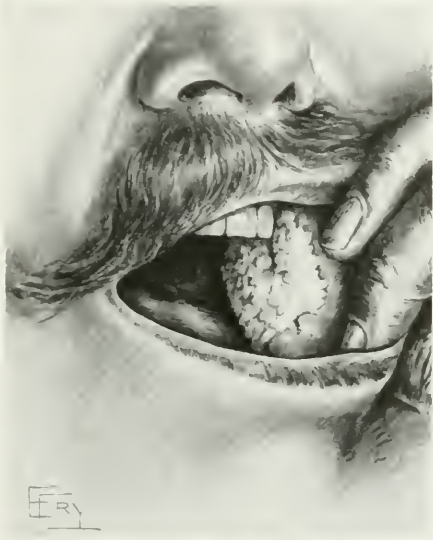


FIG. 1.—Leucoplakia of the neck (Case IX).

³Atlas of Syphilis and the Venereal Diseases, by Franz Mraček, of Vienna. W. B. Saunders, Philadelphia, 1898. Fig. 42-B.

which preceded their formation, described by the patient as "blisters." The tongue does not feel hard, and in its present condition is not painful. All delicate tactile sensibility is lost.

The chewing of highly seasoned food or sharp pieces of bread is apt to produce fissures, which, however, heal of their own accord in a few days. The epithelium of the buccal mucous membrane opposite the alveolar border is also somewhat cloudy, but not so thick as that of the tongue.

Submaxillary glands are not swollen. No demonstrable syphilitic symptoms.

The patient disappeared from observation, and the ultimate result is unknown.

In this case history it will be noted that the presence of syphilis could not be definitely shown. This exclusion in diagnosis was based upon the knowledge of syphilis as it then existed, but it must be remembered that at that

time the *spirochete pallida* had not been discovered, and the Wassermann test was unknown.

In 1909, the writer's interest in the subject of leucoplakia was again stimulated as a result of a study of a fatal case of thrush,⁴ and the article by Mikulicz in his classical "Atlas der Krankheiten der Mundhöhle" gave much additional and valuable information in the matter of differential diagnosis of this condition, and of allied diseases, characterized by patches more or less snow white in appearance which appear in the buccal cavity of affected individuals.

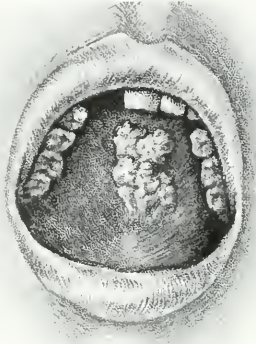


FIG. 2.—Leucoplakia of hard palate, Case I.

The illustration (Fig. 5) here shown is reproduced from the above-mentioned article.

In an attempt to review as far as possible all of the various articles in current medical literature, describing the condition of leucoplakia, it was found that such cases, while they are reported from time to time, are really of great relative rarity, and as lesions of this disease vary materially in different individuals, practically all of the cases available in medical literature are herewith collected for study and for comparison.

CASE IV.—*Leucoplakia of the tongue (Psoriasis Linguae)*.⁵ H. R., a merchant, fifty years of age, living in Eastern Prussia, was very nervous as a child and subject to epilepsy. As a young man he had frequent outbreaks of boils. In 1857, he acquired a syphilitic chancre and was subjected to a course of anti-syphilitic treatment. Later he suffered repeatedly from tumors and eruptions which healed

⁴ Thrush: A Clinical Study and Differential Diagnosis, by Henry P. de Forest, M.D., American Journal of Obstetrics, January, 1910.

⁵ Atlas der Krankheiten der Mund und Rachenhöhle. J. Mikulicz und P. Michelson. Berlin, August Hirschwald, 1892, Plate XXXI. (Fig. 3.)

after using iodide of potash and mercurial preparations. Some years ago he had severe headaches, pressure in the eyes, and dimness of vision of the left eye. These symptoms disappeared after the use of iodide of potash. The same conditions redeveloped a year ago combined with loss of memory, sleeplessness, and complete inability for mental work. At this time the patient observed for the first time some painful spots in the left half of the tongue, while eating, speaking, or in any movement of the tongue. Examination with a mirror showed him some white spots on the dorsum of the tongue, which at that time had a well-marked border and gradually increased to the present extent.

In December, 1889, the patient came to the clinic of Doctor Mikulicz; his condition is shown by the illustration herewith presented. In the well-nourished, otherwise healthy patient, no other pathologic conditions could be detected. The urine showed no abnormalities and there was no evidence of an active syphilis. Upon the trunk and the extremities were a number of large and small pigmented scars for the most part quite superficial. On the dorsum of the tongue, as shown in the illustration, there existed an irregular network of broad and narrow snow-white streaks, enclosing small islands of mucous membrane, more or less ruddy in appearance. The entire tongue has a dull surface and as a result the diseased portion is easily distinguished from the adjacent normal mucous membrane. The borders between the normal and the milk white mucous membrane are indistinct. The affected portion is more sensitive to slight motion than to firm pressure. The greatest pain is felt on the border of the tongue. Palpation discloses no difference in the consistence of the various portions of the organ. The patient formerly smoked a great deal. He has been hard of hearing for twelve years.



FIG. 3. Leucoplakia of tongue, C. II

Treatment.—Iodide of potassium and bromide of soda were given internally, one gram daily. Local treatment consisted of painting with a cocaine solution and with frequent cleansing of the mouth with a mild antiseptic. In the course of treatment of about two months the appearances almost completely disappeared. The patient felt himself mentally and bodily quite restored to health. The condition would improve or grow worse from time to time and occasionally superficial excoriations would occur which were quite painful. These raw spots healed, as a rule, in the course of from one to two weeks. The healing was hastened by a daily penciling with blue vitriol. At the end of July, 1890, the local condition remained practically unchanged.

CASE V.—*Leucoplakia of the tongue (Psoriasis Linguae).** K. K., a merchant, sixty-two years old, otherwise healthy. For a number of years there slowly developed a series of white patches upon the dorsum of his tongue. At the beginning the patient had no distress and paid little attention to this condition. During the last

*Atlas der Krankheiten der Mund und Rachenhöhle. J. Mikulicz und P. Michelson. Berlin, August Hirschwald, 1892. Plate XXXI. (Fig. 2.)

two or three years he suffered from a more or less well-marked painful sensation in the left half of the tongue. Movement, or even firm pressure of the tongue, was not painful, but while speaking or eating with ordinary movements of the tongue, he noticed a painful spot in it. Frequently the pain began spontaneously, especially when the patient was alone. When in the company of others, as a rule, he forgot his distress. The patient is a well-marked hypochondriac, and when otherwise unemployed, thinks chiefly of his condition and imagines that it indicates all possible ailments. He has consulted numerous physicians; has tried various remedies and cures without permanent relief. Unfortunately there is no record in history of the case, whether he was syphilitic, or whether he smoked to excess.

On the 7th of February, 1889, he came to the Clinic of Doctor Mikulicz for the first time. He was well nourished, did not show his age, and showed no other pathologic changes. Upon the dorsum of the somewhat broadened tongue appeared the patches well shown in the illustrations. They are of milk-white color and are



FIG. 4.—Leucoplakia of tongue, Case III.

divided by numerous well-marked dark colored lines and streaks. The surface is dull and sharply differentiated from the neighboring normal epithelium. If the finger be passed lightly over the surface of the growth, the rough velvety surface of the affected portion of the mucous membrane is distinctly felt. On the more horny portions of the growth there is no especial difference to be felt in the consistence. Both sides of the tongue show light impressions of the outline of the teeth. This is accounted for by the fact that the patient believes that absolute immobility of his tongue is necessary for his comfort.

The further course and treatment of the disease is not indicated.

CASE VI.—*Leucoplakia buccalis* (Fig. 5).⁵ R. R., forty years old, a merchant in Russian Poland, acquired syphilis when sixteen years of age. Four years ago he observed for the first time white spots on the top of the tongue which gradually increased in circumference and later similar spots appeared upon the mucous membrane of the cheek and lower lip. At the beginning this patient had no distress. But in the last few years he experienced a sharp burning pain on the left border of the tongue which increased during speaking or chewing. Since that time the patient has developed a marked hypochondriac voice. All treatment, both local and systemic, including anti-syphilitic cures, have been of no assistance. The patient smokes strong cigarettes to excess (about fifty a day). He drinks brandy also to excess.

At the time of the preparation of the accompanying plate in March, 1890, he was a well-built, well-nourished man with little to be observed, aside from the changes in the mucous membrane of the mouth. There are no other evidences of syphilis. The patches in the mouth are snow-white, of a dull surface, rather thin, and showing the color of the mucous membrane through them. Some are large,

⁵ Atlas der Krankheiten der Mund und Rachenhöhle. J. Mikulicz und P. Michelson. Berlin, August Hirschwald, 1892, Table XVI. (Fig. 1.)

LEUCOPLAKIA BUCCALIS

some are small, and some are confluent. They are distributed irregularly upon both borders of the tongue and upon its dorsum. The portions of mucous membrane between the patches are hyperæmic. A discoloration, with poorly defined edges, exists upon the mucous membrane of the cheeks and lips, in an almost symmetrical form on both sides. This is most pronounced at the angle of the mouth where there is a well-marked centre with radiating streaks. There are a number of small millet-seed patches upon the mucous membrane of the lower lip. The left side of the tongue is sensitive to motion. In the remaining portions of the affected mucous membrane, sensation is diminished.

Treatment.—The patches were painted with cocaine and boroglycerine solution. Thermo-cautery was used thoroughly over the painful area on the side of the tongue. The ultimate outcome of this case is unknown.

CASE VII.—*Epithelioma of the tongue with hair-like hypertrophied papilla following a leucoplakia of the tongue; twenty years' standing* (Fig. 7).¹ K. S., sixty years old, a post-master in Austrian Silesia. In good general health. He formerly smoked to

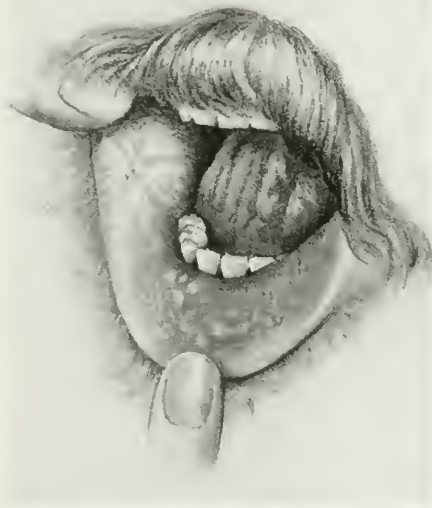


FIG. 7. Leucoplakia of the right cheek. Case VI.

excess, but denied the excessive use of alcohol. For the past twenty years the dorsum of the tongue has shown a number of white horny patches which caused no particular disturbance. Now and then he felt a moderate burning of the tongue. A few weeks ago a growth developed in the anterior portion of the left border of the tongue. This he believes was due to a sharp corner of a broken tooth. The growth gradually increased in size and finally reached its present condition. With this exception the patient complains of no other illness.

On the 14th of March, 1886, he entered the Clinic of Professor Billroth in Vienna. He was a powerful man in good condition for his years. On the tip of the tongue was a well-marked tumor represented in the illustration. It appears as an irregular nodular thickening of the tip of the tongue, ulcerated in several places. A considerable portion of the growth was covered with a milk-white layer of epithelium. Its most pronounced characteristic was the appearance of the tremendously increased growth of the papillae of the tongue (5 to 15 mm. long)

¹Atlas der Krankheiten der Mund und Rachenhöhle. J. Mikulicz und P. Michelson. Berlin, August Hirschwald, 1892, Plate XXXI. (Fig. 1.)

which surrounded like a white moustache the posterior and right border of the tumor. The larger portion of the dorsum of the tongue was covered by a thick milk-white, dull epithelial layer. The examining finger could feel a well-marked nodular tumor occupying the anterior third of the tongue in its central portion. The other portions of the mouth showed nothing abnormal; the glands were not enlarged.

On the 22nd of March, the diseased portion of the tongue was excised and the wound completely sutured. The healing was uneventful. The further fate of the patient is unknown.

The microscopical examination showed a squamous-celled epithelioma. The elongated papillae arose from a basal structure of connective tissue from one to two millimetres thick. The epithelial growth extended between the papillae into the structure of the tongue itself. This illustration is taken from the records of Professor Billroth.



FIG. 6.—Leucoplakia oris (psoriasis linguæ, tylosis, ichthyosis buccalis), Case IV.

The series of illustrations thus far presented have been selected for the purpose of illustrating the various phases of the disease beginning with the milder type

and ending with a more severe form, in which cancer is combined with leucoplakia. The ultimate outcome of this unfortunate combination is not necessarily fatal. In the case illustration, Fig. 8, a cancer of the left half of the tongue existed, combined with leucoplakia and bilateral cervical adenopathy. The cervical and buccal lesions were removed in two sittings. The small glands on the right side were unfortunately left in place. Fulguration, March 21, 1909. The patient was cured for nearly three years. The source of this case report is unknown, but it was obtained in recent medical literature.

A careful study of this series of cases, which, though not numerous, epitomize practically all of the cases that have been reported in current medical literature for the past thirty years, discloses certain facts which are worthy of more careful and detailed consideration.

Synonyms.—The disease itself, although it has been recognized and described by a number of writers, has never until recent years been given a

definite and well-recognized name. It has been variously described under the following titles:

Leucoplakia buccalis, psoriasis linguae, tylosis oris, buccal keratosis, ichthyosis buccalis, plaques nacrées, chronic superficial glossitis, leukonia, raucherplaques, plaquesnarben, lingual psoriasis, epithelial white plaques of the tongue.

The present title of leucoplakia buccalis appears to have been first suggested by Merklen at the Congress of London in 1881, and was accepted by *Hillairet*, *Kaposi*, *Vidal Clément*, *Duncan Bulkley*, *Behrond* and *Wilson*. Two years later it was taken as the title of an article by *Leloir*, and since then it has been incorporated and accepted in current medical nomenclature. The other designations above mentioned have been proposed both before and after 1881, but have not been generally adopted. Each name represents an attempt on the part of the person proposing it to describe the salient feature and real nature of the disease. To enumerate them is to trace the history of the different opinions which have been expressed.

Schwimmer proposed the name of "White Plaques of the Mouth." This is mentioned for the sake of completeness, for it is merely a synonym of leucoplakia buccalis.

Definition.—Leucoplakia may be defined as a chronic and progressive affection of the mouth, characterized by the occurrence upon the mucous membrane of snow-white patches, sometimes circumscribed, sometimes diffused.

Historical Sketch.—Bazin, in 1868, in his "Leçon Clinique," described the disease under the name of "Lingual Psoriasis," and made a study of this condition which has remained classic. Without giving the name "Psoriasis" the exact meaning which really belongs to it, he believed it to be a constant accompaniment of arthritis. In 1878, Deboe in a thesis, and Mauriac in an



FIG. 7.—Leucoplakia of tongue with epithelioma, Case VII

important article, without agreeing with the ideas of Bazin as to the nature of the disease used the term "Psoriasis," which gives a good idea of the general aspect of the lesion and is not ambiguous. The English school, impressed particularly by the hardness assumed by the mucous membrane, becoming as Hulke says, like kid leather, proposed the name of ichthyosis, which was adopted by Clark and by Morris, and has persisted up to the present time. Before this time, Clark had attempted to make London physicians accept the term, tylosis linguae. This was rejected by the English, but was accepted by Ullmann of Germany, and by Lallier of France. This title has since been given up. Devergie, in 1876, without success, proposed the name

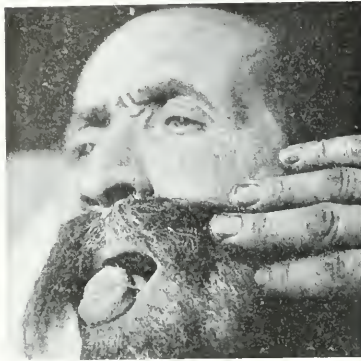


FIG. 8.—Cancer of the left half of the tongue, with leucoplakia and bilateral cervical adenopathy. Removal on two sittings of the cervical and buccal lesions. The small glands on the right side were left in place (unfortunately). Fulguration, March 21, 1909. Cured for nearly three years.

of epithelial white plaques of the tongue. Recently Doyon and Besnier have been equally unsuccessful in regard to the terms, chronic epithelial glossitis, and buccal keratosis.

This disease which has been described under so many different names, and which we shall hereafter refer to as leucoplakia buccalis, has an obscure history. This is due, not only to the various terms under which it has been described and the dissimilar ideas expressed in regard to its pathogenesis, but also to the fact that it has a varied etiology, and under this name many inflammatory conditions of the tongue have been included which look

alike but which are in reality totally different in character.

Etiology.—The etiology of this disease is in part still obscure. It is certain that the predisposition to abnormal tenderness and the lack of resistance of the mucous membrane may cause irritation of the oral cavity.

Leucoplakia buccalis is essentially a disease of adults. So far as age is concerned, it is most frequent in the fifth or sixth decade of life; it rarely occurs before the fortieth year. It is a rare occurrence in women (one to sixteen, according to Clark, and one to thirty-five, according to Leloir). According to Deboe, it exists only in men.

It is described by some writers as an occupational disease: "The White Plaques of Glass-Blowers." Still other writers have regarded it as a constitutional disturbance. Arthritis and a variety of herpes seem to play an important rôle in the causation of a number of cases. Anemia, consumption, diabetes, or any disturbance of digestion may be factors in the etiology.

Leucoplakia has been noted in connection with special irritative condition

of the digestive tract, such as dilatation of the stomach. In some instances it appears to have developed as a result of the irritation of the tongue, due to faulty dentition, or sharp corners of broken teeth. The habitual use of alcohol is an undoubted factor and so also is the use of highly spiced and irritating foods and condiments. Protracted medication with such drugs as the mercurials or the iodides are predisposing causes. So, also, is the habitual inhalation of smoke and dust.

The principal cause is undoubtedly the smoking of many and strong cigars or cigarettes, or the use of tobacco in short-stemmed pipes. The nicotine of tobacco is not the only cause, but the combustion products of the tobacco, such as carbonic acid gas, ammonia, creasote. All empyreumatic oils are especially irritating.

This fact accounts for the much greater preponderance of leucoplakia in men than in women, for it has been observed that in those countries where women also smoke to excess, leucoplakia occurs equally in both sexes.

Many writers have regarded this disease as habitually depending upon the former syphilitic affection, and therefore have described it as a symptom of syphilis. This view does not seem to be supported. The carefully compiled statistics of Erb and of Neisser show that in a large number of typical cases of leucoplakia, syphilis could be excluded. Especially convincing in this particular are the number of cases observed in which a patient who had suffered from long-standing leucoplakia had developed a primary syphilitic lesion with the secondary symptoms appearing in due time. If the disease of the mucous membrane were of specific origin, the patient would then be immune against a new syphilitic affection. The resistance of leucoplakia to ordinary anti-syphilitic treatment, also supports the belief that it is not due to this disease. If leucoplakia really exists, it is made worse by such treatment. Mercury appears to be without effect, though there is a slight filling of the mucous membrane as a result of its use, and there is no doubt that the long-continued use of mercury, of the iodides alone, or of both together, tends to irritate the mucous membrane, and possibly produce a variety of leucoplakia. That these growths do not go on to the thick and horny formation of other forms is because the injury caused by mercury is a transitory one. When it is no more needed its use is stopped, while smoking and drinking are, in many instances, continued throughout the entire life.

If, however, syphilis is not to be regarded as a direct cause of leucoplakia, there is no doubt that it is an important predisposing factor in the occurrence of this condition. Schoengarth published a list of all the hitherto reported cases of leucoplakia which he could collect; 65 per cent. show a syphilitic history. The great improvement made recently in the accurate diagnosis of syphilis by the Wassermann test will unquestionably do much to eliminate syphilis as a causative factor in many cases where its existence was formerly suspected but could neither be verified nor excluded. All authors have agreed that leucoplakia is an extremely rare occurrence in women, though syphilis, of course, occurs in practically the same number of women as in men.

Tobacco and syphilis must be regarded as the most important factors in etiology. Where syphilis exists it is probably true that less smoking is necessary to develop leucoplakia. Erb is right when he says that unless these two causes are present, leucoplakia is rarely found.

Symptomatology.—The symptoms of this disease are usually quite evident. There appear to be two fairly well marked clinical forms of leucoplakia. The *undeveloped form* and the *common form*.

The *undeveloped form* has been thoroughly studied by Benard. This usually occurs in patients suffering from gout or arthritis, and particularly in persons who are excessive smokers. Its beginning is very insidious. Its advance slow, almost imperceptible. It is accompanied by almost no disturbances. On examination of the mouth, particularly the tongue, a slight turgescence of the papillae is noticed, accompanied by a hyperaemia of the mucous membrane. The normal furrows of the tongue are markedly accentuated. This is the so-called "Parquet" tongue, characteristic of gouty people; it may persist for years. Gradually the tongue becomes gray and then white. At this stage where hypertrophy of the papillae is much more evident, each one of them is covered with thick epithelium, and examination shows that the pearly-white coloration is found only at the base of the inter-papillary furrows. This intermediary stage may persist for months or years; finally a light desquamation takes place, small superficial ulcers are formed, and true fissures develop in place of the furrows. At all stages of this type of the disease, the treatment of the coexistent constitutional condition produces an amelioration of the local affection.

In the common form the symptoms are much more typical. There are often pronounced functional disturbances, stiffness of the tongue, difficulty of speech, mastication and swallowing. Later ulcers and fissures develop, finally accompanied by pain. Salivation and an occasional hemorrhage occur, due to tearing of the tissues underlying the base of the deep fissures. The lesions exist in very irregular patches. They are grayish-white, pure white or sometimes of a glistening iridescent white, suggesting mother of pearl (plaques nacrées, Fournier).

Clinically these areas appear as quite smooth, dry, milk-white patches, hence the name. The more recent layers of epithelial thickening are relatively thin, show a more rosy-red color, and are not sharply separated from the surrounding tissue. The affected spot appears as if the mucous membrane had been slightly touched with nitrate of silver, or lunar caustic. Through the thin whitish layer, the normal red of the mucous membrane is visible. The older masses appear as thick rinds and are of a pure white or bluish-white color. These masses are for the most part sharply differentiated from the adjacent mucous membrane, and there is frequently an inflamed red border surrounding them, less than 1 mm. wide. As time goes on these rinds become progressively thicker, and more like leather. They are markedly raised and as a result are easily torn free from the underlying tissue by mechanical means such as the teeth, the movements of the tongue or

hard particles of food. Fissures of the superficial tissues develop, extending deep into the tissue of the tongue itself. Slight hemorrhages occur from accidental causes, and the rinds then assume yellowish or brownish colors, which are transitory, for the white color reappears as soon as the blood is reabsorbed.

As a rule leucoplakia is limited to the anterior portion of the dorsum of the tongue, either at the tip, or upon its borders where are found patches, large or small, isolated or coalescent. The upper surface of the tongue as the result of this growth, presents a peculiar faceted appearance, though, as a rule, the outlines are quite irregular, especially when new growths are interposed between those of long standing.

Infrequently similar growths appear on the inner surface of the cheeks and lips. A characteristic growth often appears at the junction of the upper and lower lip where leucoplakial streaks may radiate from the angle of the mouth in a fan-like fashion. If the lips themselves are involved, the growth progressively diminishes toward the vermillion border. More rarely it attacks the hard and soft palate. The gums and alveolar processes are almost never involved.

Fissures appear most frequently upon the surface of the tongue itself, since this organ is most apt to be injured by mechanical means as a direct result of its mobility and function.

If the patches themselves are subjected to a microscopic examination, it is found that the pavement epithelial cells of the white patches are more or less enlarged and thickened, the submucosa is filled with lymphoid cells; the blood-vessels are increased, dilated and surrounded by a small-celled infiltration. When the growth has persisted for some time, a horny thickening of the superficial epithelia takes place, oftentimes accompanied by a marked increase in the size and length of the papillae. In the lower layer of the epithelium there is a marked stratification of the cells and a sort of cup-like formation of the nuclei in the midst of this horny epithelial layer. A peculiar substance, eleidin, appears to be produced as a result of the horny changes in the epithelium.

The *pathological anatomy* of these growths was exhaustively studied by Leloir, who notes three successive phases of development.

First, the hyperkeratinization of the mucous membrane which becomes horny, hypertrophied, and shows a granular layer rich in creatin or eleidin. This layer then swells and becomes very large as a result of this thickening of the horny layer.

Second, the formation of ulcers, as the result of this excessive hardening. These take the form of fissures within the plaques themselves, and around their edges. These fissures extend completely through the mucous membrane as far as the papillae and as a result cause inflammatory lesions, exfoliation, desquamation and infiltration. A pronounced change in the submucous glands may also develop.

Third, the last phase shows a thickening and hardening of the dura around

the plaques. Sclerotic atrophy of the blood-vessels with dis-association, compression and atrophy of the muscular fibres occur. In this stage the underlying tissues may be involved, disintegrate, and favor the invasion of agents leading to the formation of epitheliomata. Upon the edges of the organ, deep indurations may develop, sometimes very painful and accompanied by rapidly developing adenopathy. If the usual form of cancer of the tongue develops, it progresses with its usual malignity, though certain cases have been observed in which an early excision of the cancerous growth appears to have been followed by permanent cure. In the later and more marked development where cancerous changes do not occur, the papillæ form warty, spinous or shield-like prominences, still preserving their sharply marked outlines.

As a general rule there are found at this stage torn furrows, and gaping rhagades appear on the lips and on the tongue, that is in those parts where, as a result of their musculature, movements are most pronounced. These patches do not change into ulcers. Papillomatous growths on the borders or in the fissures of the patches are occasionally observed, not unlike a chicken's comb in appearance.

A similar discoloration of the epithelium has been observed upon the mucous membrane of the vulva of the uterus and even of the kidneys. In rare instances it has been observed in the skin eruptions of psoriasis and in lichen planus.

The subjective manifestations vary materially in different patients. In the greater number of cases in the early stage of the disease, there is almost no discomfort, and the trouble not infrequently is discovered only as a result of a feeling of an annoying burning of the mucous membrane of the mouth, or of the sensation that a foreign body is lying upon the surface of the tongue or cheeks which needs to be removed. An examination by the patient with a mirror is then made and the incipient leucoplakial patches are discovered. There may be great sensitiveness in speaking, eating, drinking or smoking. The use of spiced foods or of alcoholic drinks often causes especial irritation. In the later stages when the thickened and horny condition of the epithelium has developed, there may be but little distress except the discomfort complained of from the stiffness and difficulty in moving the tongue and lips, in chewing or in speaking. If the epithelium be distorted to a large extent by furrows, ulcerated fissures, pronounced excrescences or carcinomatous infiltrations, the affection may become very painful. In such cases hemorrhages often occur. The alteration in taste or in salivation is rarely observed unless the disease is extensively developed.

Diagnosis.—The detailed account of the lesions observed and the symptoms to which they give rise, described in the preceding section, should make the diagnosis of this disease a matter of comparative ease and certainty.

In view of the fact that syphilis has played such an important rôle in considerably more than half of all of the cases of leucoplakia which have been reported, the positive exclusion of this disease or confirmation of its existence should always be made by means of the Wassermann test.

If a man be suffering from syphilis, he often regards these patches as a manifestation of that disease. Other patients believe that cancer is about to develop. These two conditions are generally regarded by the laity with great apprehension, and therefore many patients with leucoplakia become hypochondriacs upon this subject. They magnify their symptoms of discomfort in the mouth and attribute to the disease much greater importance than really attaches to it. There is a real reason for anxiety, however, for in not a few cases in which leucoplakia was first observed an epithelioma of the tongue developed later, but it is not always easy to determine whether the cancerous growth took its origin in the leucoplakial patch or in some other local irritation of the organ. The same causes of irritation of the tongue and mucous membrane favor the development of this form of carcinoma quite as well as of leucoplakia itself. It would be quite erroneous to maintain that every case of leucoplakia ultimately terminates in carcinoma. Moderate degrees of leucoplakia are far more frequently seen than severe cases of the disease, and in many cases the condition remains stationary for years, even for decades. We must admit in view of the number of cases of leucoplakia which have been reported in which epitheliomata subsequently developed that this disease may be regarded as a predisposing factor in the formation of cancer of the tongue. The extreme degree of mental apprehension, hypochondriasis, or well-marked neurasthenia, which have been observed in severe cases of leucoplakia, should of themselves be regarded as important factors in an accurate diagnosis of this disease.

The illustrations selected show well the various stages of the disease in various localities of the oral cavity, and should greatly facilitate or confirm the diagnosis.

Differential Diagnosis.—Certain diseases of the mouth always give rise to white patches upon the mucous membrane. No one unfamiliar with the classical "Atlas of Mikulicz" can realize that an entire volume may well be devoted to the diseases of the mouth alone. Many of these diseases differ materially in their clinical appearance from the lesions of leucoplakia, but certain ones are to be borne in mind where any question of diagnosis arises.

In infancy, thrush, acute gonorrhoeal stomatitis, Bednar's aphthae (Bednar's plaques, ulcera pterygoidea palati) are most frequently observed. The age of the patient alone should serve to differentiate these conditions from leucoplakia, although thrush also occurs in adults.

In the adult, the three conditions most apt to be confused clinically with the disease under discussion are those of aphthous stomatitis and chronic recurrent aphthae. The clinical history of these diseases is quite characteristic.

Acute papular glossitis, an extremely rare disease, more closely simulates leucoplakia buccalis so far as the pure white color is concerned than any other buccal affection, but the shape of the lesion with a depressed centre and a snow-white periphery easily serves to differentiate the two conditions. The article of the writer upon "Thrush," which has already been mentioned, gives further details of differential diagnosis.

Another disease in the adult with which leucoplakia may sometimes be confused is tuberculosis of the tongue. This disease is also extremely rare in the buccal cavity, but the possibility of its occurrence must always be borne in mind.

As a rule the form of tuberculosis which develops is of a non-malignant type and oftentimes, though chronic in its course, can be cured by the use of superficial thermo-cautery combined with the administration of iodide of potassium internally. The growth itself is not of the silvery white observed in leucoplakia, but has a greenish tint and tends to ulceration. A number of excellent illustrations of this condition may be found in the volume of Mikulicz already cited.

Miliary tuberculosis of the tongue may develop which resembles leucoplakia much more closely than the ulcerative form just mentioned.

It is also possible to confuse leucoplakia with lichen-ruber planus. In this growth there are occasionally found smaller and larger isolated or confluent white patches on the lips, cheeks, tongue, gums and soft palate which appear very similar to the leucoplakial growth. According to Touton, the group-like formation of the patches and the net-like streaks, as well as the formation of definite nodes and the simultaneous or shortly following affection of the outer skin, serves to distinguish them. The internal use of arsenic combined with the local application of corrosive sublimate rapidly cures the lichen planus, while leucoplakia is practically unaffected by this treatment.

Most important of all in the differential diagnosis is the fact that certain lesions of the papular form of syphilis which occur in the oral cavity sometimes closely simulate in general outline the growths of leucoplakia. The persistence of the patches in true leucoplakia is an especial characteristic; they remain for months at a time at one and the same place in spite of all treatment, whereas the syphilitic papules as well as benign growths remain for a much shorter period in any one place, and either extend their borders rapidly or heal. Although the leucoplakial patches never change into ulcers though fissures may sometimes develop, the syphilitic patches after a short time usually become superficial ulcers. The leucoplakial growths with the passage of time become steadily harder, more resistant, and finally, warty or horny; the syphilitic growths soon coalesce and become slightly coherent and soft. Syphilitic patches heal with relative promptness under general and local treatment without scars, whereas leucoplakia is rarely influenced by the use of mercury or iodine; in any event there always remains a depressed central scar.

To add to this confusion certain forms of syphilides, particularly of the large macular variety, show first a roseola which may disappear without leaving any appreciable change in the skin, or on the other hand, in rare instances, a slight, barely noticeable desquamation of the epidermis in the affected areas occurs after the disappearance of the eruption. More frequently the pigmentation disappears, so that the affected parts appear white and lead to the formation of cutaneous leukoplasia, though the pigment disappears in

the centre of the eruption it may be increased around its periphery. This is particularly the case in parts naturally rich in pigment, as the nape of the neck and the genital region. Occasionally the entire surface of the body is thickly covered with pale, non-pigmented, circular or oval spots. This so-called syphilitic leukoplasia is a more valuable sign than any other, as it may represent the remains of a cutaneous syphilide of very long standing and form a diagnostic point of the highest importance in doubtful cases of diseased organs.

The mucous membrane of the oral cavity is almost always involved during the secondary period of syphilis. Papular ulcers and fissures are constantly found. The alterations which are produced in the tertiary stage are known as *syphilitic pachydermata* or *psoriasis mucosæ oris*; they occur in the mucous membrane of the tongue, the cheeks, especially opposite the teeth, and in several other localities. The characteristic sign is a thickening of the mucous membrane with the formation of whitish patches consisting of several layers of proliferated epithelium almost as hard and horny as the skin.

There is scarcely an organ in the body in which syphilis deposits so many and such various pathologic products as in the tongue. The later stages of secondary syphilis are often marked by papular eruptions and ulcerations along the margin of the tongue and by extensive infiltrations on its surface. Among the tertiary forms some writers include so-called psoriasis or leukoplasia of the tongue. These facts have been so long observed in connection with syphilis and the terminology employed is so similar to that of leucoplakia, that there is little doubt that much confusion has occurred in the accurate diagnosis of these similar conditions of the mouth. In many instances there is no doubt that leucoplakia and syphilis have co-existed. In other cases leucoplakia has been regarded as a late syphilitic manifestation. At the present time this confusion can easily be avoided by the routine use of the Wassermann test in all cases of leucoplakia which come under observation.

The case herewith submitted of leucoplasia is taken from Mraček.*

CASE VIII (Fig. 9).—*Leucoplasia of the neck. Papules on the genitalia.* A. B., eighteen years old, servant girl. Has never had a venereal disease. In the beginning of December, 1895, she began to be troubled with burning during micturition; at the same time several "pustules" developed on the outside of the labia majora, which burst after several days and healed over. There was also a painful swelling of the right inguinal glands, lasting several weeks and disappearing finally after rest in bed and the use of compresses. In February, 1896, she was troubled with pain in the throat, and for two weeks was unable to swallow solid food. These symptoms improved after gargling with alum. A few days afterward an erythematous eruption appeared on the throat, on the flexor surface of both elbows, and on both legs. Since the end of March the eruption has been brown. On May 23 she came under hospital treatment; up to that time she had not consulted a physician. Last coitus six months ago; last menstruation, April 29. Has never given birth, nor had an abortion.

Present Condition.—Eroded, œdematous papules on both large and small labia, especially on the right side; inguinal glands on both sides much enlarged; at the

*Atlas of Syphilis and the Venereal Diseases, by Franz Mraček, Vienna. W. B. Saunders, Philadelphia, 1898.

anus the mark of an old papule. On the lower extremities a specific eruption in process of regeneration; intense leukoplasia of the neck; both tonsils enlarged and ulcerated.

Cured after twenty injections. (See Fig. 9.)

With this history it is little wonder that with the characteristic white spots on the body confusion in diagnosis could easily occur if similar white areas appeared in the buccal cavity.

Prognosis.—The course of leucoplakia is always a very chronic one; it may become limited in its growth within a few months, or may persist for



FIG. 9.—Leukoplasta of the neck. Papules on the genitalia, Case VIII.

ten, twenty or thirty years; indeed, throughout life. More frequently there are periods of activity, alternating with periods of quiescence and excess in smoking not infrequently causes a desquamation of the epithelial masses. Prognosis, except in cases where syphilis co-exists and mercury is of help, is very doubtful. Leucoplakia often occurs without material discomfort, and occasionally is cured spontaneously. On the other hand, a permanent cure is the exception. The prognosis therefore is dubious. According to Schuchardt, any chronic irritant affecting either the skin or mucous membrane by producing an increased vascularization of the tissue favors the formation of cancer. The presence of leucoplakial patches in the mouth, therefore, increases the liability to this unfortunate termination. Even if excision of the cancerous growth performed at an early stage, recurrence is frequent. The occurrence of carcinomata in leucoplakia deposits, though it sometimes does happen, cannot be regarded as the rule.

It is possible that the treatment practiced and advocated by the writer and described later in this paper may materially affect the prognosis of this disease.

Treatment.—When the clinical history of a case of leucoplakia is carefully considered it is apparent that the prophylaxis is quite as important as the

administration of medicine or any local treatment which promises to relieve the condition.

The preventive treatment which should be at once begun is self-evident from the clinical history of the disease. The use of tobacco in all forms must be stopped. Most patients themselves observe that with the cessation of smoking their trouble is materially improved, and if they begin again it is made worse. It is a severe punishment for a confirmed smoker to give up this habit, particularly because of the appearance of an apparently harmless disease, so in most cases the best we can do is to limit the daily number of cigars or cigarettes, and to recommend the habitual use of a long cigar-holder. Short pipes must be prohibited. It must not be forgotten that tobacco juice is also a powerful irritant to mucous membranes so that chewing tobacco must also be forbidden. If possible, after a progressive diminution in the use of tobacco, its use in any form should be entirely discontinued.

The use of mercury must be excluded as well as any irritation of the mouth by acid, acrid or irritating foods, drinks or spices.

If the teeth are broken or decayed, pointed useless roots should be extracted and the cavities filled. In fact, all causes of irritation of the mucous membrane of the mouth are to be removed.

Dyspeptic disturbances, consumption and anaemia must all be cared for according to their respective needs. Anti-syphilitic treatment is not only unnecessary, but even harmful as Erb early maintained. This, of course, presupposes the fact that the existence of syphilis has been excluded by the Wassermann test.

Unfortunately the disease is very resistant to treatment, and as is usually the case in diseases of obscure etiology, many local applications have been recommended. In the milder cases, antiseptic and slightly astringent mouth-washes can be used to keep the mucous membrane in good condition and to allay the patient's apprehensions. Tincture of myrrh, tincture of nutgalls flavored with a drop or two of oil of peppermint, peroxide of hydrogen, and similar medications can be tried. No one of these should be continued too long as the taste of the patient varies materially from time to time. The treatment of single patches of leucoplakia in obstinate cases is best done by means of caustics. Pure lunar caustic, a 50 per cent. solution of nitrate of silver, a 5 per cent. solution of lactic acid gradually increased to 50 per cent., chromic acid solutions, and, more recently, concentrated preparations of peroxide of hydrogen, are all to be recommended. Salicylic acid is of value to aid in the dissolving and softening of the mucous membrane. A 2 per cent. solution of resorcin has been used. Rosenberg recommends the painting of the patches with pure balsam of Peru, allowing it to stay in the mouth for from three to five minutes.

Unfortunately in most cases, this entire list of medication proves to be of no value, and often this very lack of result confirms the patient in his belief that he has an incurable disease which will ultimately end in cancer. Many cases therefore give rise to a severe form of hypochondriasis, although, as a

rule, the patient suffers but little discomfort. If speaking, eating, and drinking are interfered with, mental disturbance is still more apt to occur.

Some writers advocate that as soon as the patches of leucoplakia develop to any extent, they should be thoroughly curetted away and the base cauterized with the thermocautery. Or the tip of the tongue can be firmly grasped in a bit of gauze and with a sharp scalpel the patch of leucoplakia can be shaved off exactly as the skin is removed for transplantation.

Rinssohoff gives preference to the procedure of decortication of the skin after first sprinkling the affected areas with crystals of permanganate of potash. After this procedure there is often left in place of the sensitive rind a soft insensitive scar. Such a procedure can hardly be necessary in patches of small size, but at any rate it prevents the later development of larger growths. The effect upon the patient's mental condition of the absolute removal of the growths by any of these procedures is usually a salutary one if the treatment be successful. On the other hand, if it be unsuccessful, these procedures only make the mental attitude of the patient worse. One is certainly justified in regarding the condition as harmless as long as the area of the lesion is not extensive.

The possibility of the ultimate development of an epithelioma should in all cases be stated to the patient, and if such a growth begins to develop, radical surgical procedures should be at once instituted.

This in its essentials indicates the line of treatment which has been pursued by many physicians at many times. The very fact that such a large number of remedies have been suggested indicates the little knowledge which we possess as to the true cause of the disease and the uncertainty of all forms of treatment that have been mentioned.

Personal Observations.—Up to the time that I prepared my article on "Thrush," the subject of leucoplakia to me had but an academic interest. No case of the disease had ever come under my observation, and in view of its extreme rarity, it seemed improbable that I should ever be called upon to care for a patient suffering from this disease. On June 9, 1911, however, there was referred to me by Dr. Francis J. Magilligan, of Brooklyn, a patient whose history was a typical one. The result of treatment, involving as it did certain phases of medication, never before used, so far as I am aware, quite surpassed all reasonable expectations.

CASE IX (Fig. 1).—J. O. S., a native of Ireland, sixty-three years of age, a former member of the Police Department of this city. Family history negative. His mother died in childbirth; his father, at the age of eighty-two.

Personal History.—He formerly chewed a package of tobacco a day, and he himself concluded that this caused the onset of his trouble. He stopped chewing tobacco six years ago. He has smoked since he was a small boy, using a pipe indoors and cigars outside. He was a total abstainer until twenty-four years of age; since then he has drunk beer and whiskey in moderation. He likes to have his food highly spiced. He is regular in his habits, was twenty-five years in the Police Department, and looks young for his age.

His present illness was first noted in 1894 when a snow-white patch appeared on the inside of his left cheek opposite the first molar tooth. This has grown

steadily forward until it is now an oval patch 6 cm. long and 3 cm. wide. This covers practically the entire inner surface of the left cheek. This patch is snow-white in color, is raised 0.5 cm. above the level of the adjacent mucous membrane and is crossed by numerous deep fissures extending well into the substance of the cheek. These fissures bleed freely upon examination or while chewing his food. The mass is composed of a large number of thick, pearly-white, glistening, hypertrophied papillae closely overlying each other like an exaggerated piece of white velvet. It was not painful unless torn by some mechanical means. Its appearance when first seen was well shown by the accompanying sketch made at the time.

All forms of treatment appear to have been tried by the many physicians whom he has consulted during the seventeen years that this mass has been in existence. It was thoroughly burned with chromic acid by a prominent dermatologist; this caused much pain, but the growth continued. His former family physician burned it with nitric acid and gave him a red mouth wash to use. This had no effect, so a number of pieces were cut off with scissors and the base cauterized. At the end of a year of this treatment the condition was much worse than it was at the beginning. Thermo-cautery was used by another physician; this caused much pain, gave no improvement and the patient never returned for observation. A large number of mouth washes and various medications have been used—the formulas of these he does not know.

I first advised to discontinue the use of tobacco and alcohol entirely, have his teeth carefully cleansed and begin for the first time the habit of brushing them regularly each day. An alkaline mouth wash was advised for local cleanliness. Local application was made with pure carbolic acid over the patch, which after a moment or two was neutralized with pure alcohol. After a month of observation the growth appeared to be somewhat thinner in the centre and I had hopes that the prophylaxis and treatment which he had followed carefully would permanently relieve him.

Upon my return home from my summer vacation early in September, I found that for the preceding month, the patient had suffered much pain inside of the face, sometimes of great severity, and the area of growth was practically the same as when it was first seen.

It then occurred to me that inasmuch as leucoplakia is so frequently associated with syphilis, and though undoubtedly a different disease, closely resembles syphilis in some important particulars, it might be due to some organism similar in character to the spirochete pallida or to some form of protozoa. If a large dose of arsenic administered intravenously would destroy the spirochete, as it unquestionably does, possibly a similar treatment would have the same effect in this disease.

In order to be sure of the diagnosis and to exclude syphilis, the patient was referred to a reliable laboratory and the Wassermann test was made. Two tests were made by two different laboratories. In both instances the test was negative. Syphilis, therefore, could be excluded.

On the 14th of September, a full dose of salvarsan was administered in the median basilic vein of the left arm. Some difficulty was experienced in entering the vein with the needle for, because of the anemic condition of the patient, the veins almost collapsed. He had a slight chill immediately after the injection; stimulation was given him and he was put to bed. Late in the afternoon he insisted upon returning home with his wife. The usual diarrhoea with some nausea, which frequently follows injections of 600, lasted for an hour or two, but by midnight his discomfort was at an end. He slept well that night for the first night in a month, and when seen four days later, stated that he had been entirely free from pain in his face ever since the injection was administered.

On the 23rd of September further increase in size of the growth had stopped and the edges had begun to separate noticeably from the underlying mucous membrane. The growth now appeared as if it could be lifted off from the surface of the cheek. This separation progressively continued, and on the 5th of October, he appeared before my clinic at the Post Graduate Medical College. No physician of the score or more who were present had ever seen a case of leucoplakia. This illustrates the rarity of the disease. By the end of October the growth had steadily separated from the periphery toward the centre, healing as the recession advanced, and early in November, when the patient was last seen, the leucoplakial growth had entirely disappeared and the mucous membrane lining the left cheek appeared to be in quite as healthy a condition as that of the right. He still suffered from anemia, for which tonics and iron were being administered, but so far as the

disease of his cheek was concerned, he was cured. He still remains cured. There has been no recurrence.

So far as I can determine this is the first time in which 606 was administered for the cure of leucoplakia, and the results secured could certainly not be surpassed.

A year elapsed before I had an opportunity to see another case, but on May 21, 1912, a former patient reappeared.



FIG. 10.—Leucoplakia at angle of mouth. Drawing from life (Case X.)

CASE X (Fig. 10).—*Leucoplakia of right angle of mouth.* J. A. S., an American, twenty-nine years of age. His family history was negative. He has had no

serious illness. He stated that he had a chancre eight years ago, but no secondary symptoms ever developed, and his family physician believes that the sore noted was probably herpetic or a chancroid. No evidence of syphilis could be detected; there was no adenopathy.

When first seen in 1911, he came for an operation for a tumor of the left spermatic cord. This was removed by operation and proved to be tubercular in character. He came to my office after a year's absence in order that I might observe the ultimate result of the operation. The scar could be with difficulty determined, and there was no secondary involvement of the neighboring parts.

The patient called my attention to the fact that on the right side of the mouth

there was a growth which had started during the previous year and which appeared to be extending. Examination showed this to be leucoplakial in character, of the typical fan-like arrangement of four or five striae, 1 mm. in width, extending posteriorly from the angle of the mouth upon the right side. The central strips were 2 cm. in length. The lateral ones were not so long. No pain had been experienced, but it was an annoyance to him in speaking and he felt continually obliged to rub the growth with the tip of his tongue.

A Wassermann test was made but proved negative. With the experience of the former patient fresh in mind, no attempt was made at any local treatment, save the penciling over the mucous membrane once or twice a day with a solution of permanganate of potash and a mouth wash of three parts of alcohol, one part of glycerin and six parts of water. The usual full dose of salvarsan was administered. The growth progressively decreased in size and at the end of a month the mucous membrane of the buccal cavity was normal. No recurrence has taken place.

CONCLUSIONS

Leucoplakia buccalis then may be regarded as a chronic, slowly progressive disease over the buccal mucous membrane.

The etiology of the disease is unknown. Local irritants in the mouth are unquestionably factors in its production, but it is probable that it is a disease of parasitic origin. Just what the parasite is remains to be determined, but that it is similar in character to the known parasite which causes syphilis and to the unknown parasite which often leads to the production of epitheliomata in the same region, is probable. Whether this parasite resembles the spirochete, whether it is a protozoal form similar to a plasmodium of malaria, of Texas fever, of sleeping sickness or of other diseases, is not known. At any rate, it seems probable that it may be destroyed by the same means now at our disposal which will destroy the spirochete. The writer has used salvarsan in two cases of malaria in which the plasmodium was found before the injection. Both patients have never had a subsequent chill, all their malarial symptoms have disappeared, and health has been restored. Subsequent examinations of the blood failed to show plasmodia. In one instance of non-operable small round-celled sarcoma of the upper jaw, subsequent to an operation where the entire superior maxilla was removed and the diagnosis determined beyond all question in one of the best hospitals in the city, this remedy was also administered with excellent results. Pain was eliminated, and for at least a year no further progress of the disease took place. It seems probable that arsenic administered in this form may be safely and widely used in all forms of disease of parasitic origin, non-bacterial in character. The capsule surrounding most of the bacteria appears to prevent the destructive action of arsenic and thus prevents beneficial results from being secured by the injection.

It, of course, would be unwise to predict that all cases of leucoplakia can be as readily cured by this means as the two which have been recorded, but at any rate, it is safe to state that a new weapon has been found which will in some cases at least act efficiently as a cure for a disease notoriously resistant to all former methods of medication or of treatment.

ABSCESS OF THE TONGUE

By ABRAHAM O. WILENSKY, M.D.

AND

JOSEPH HARKAVY, M.D.

OF NEW YORK, N. Y.

It is a remarkable fact that acute infection of the tongue, in spite of the situation of the latter in an environment full of innumerable sources of infection, is rather rare. According to Combiér and Murad,¹ the frequency of such infections of the tongue is, indeed, in marked contrast to that of infection of the tonsils, the floor of the mouth and the naso-pharynx. The tongue escapes these dangers partly because of the special firmness of its mucosa, because of the absence of any submucous areolar tissue, because of the compactness of its parenchyma, as well as because of the nature of its musculature. Nevertheless, acute infections of the tongue do exist and are known. It is sufficient to refer to the descriptions of M. A. Bruce in the *Traité du Duplay et Reclus*,² to that of Morastin in the *Traité du Dentu et Delbet*³ and to that of Lebormant in *Precis de pathologie externe*. The subject has given rise to only a small literature of which, perhaps, the most important communications of the older group are one by Caulier and one by Thibaud⁴ and of which the most important communications of the more recent group are one by Saenz⁵ and one by Auperier.⁶ Bennet,⁷ in collating the literature from 1816 to 1909, was able to record only one hundred and forty-five instances of acute infection of the tongue. Butlin⁸ also emphasizes the rarity of acute disease of the tongue.

CASE REPORT

S. A., age sixty. Three or four days previously, the patient had caught cold, and had a running nose, fullness in the head and sore throat. Otherwise he disclosed no abnormalities. Except for some headache there were no marked constitutional symptoms. He was given the usual symptomatic treatment with some relief. On the third day following the first examination, the patient began to complain of some pain in the posterior part of his tongue; aggravated on motion of the organ. Accompanying this was some difficulty in swallowing and talking. These symptoms became rapidly aggravated and within twenty-four hours the tongue became swollen so that protrusion from the mouth was almost impossible and then only with extreme pain, lancinating in character, referred to the left ear, indicating an involvement of the chorda tympani nerve. At about the same time the patient complained of pain in the left loin which radiated down to the groin.

The past history of the patient had certain important features which made the present status somewhat complicated. A number of years ago the patient had acquired lues. Since then (eight years ago) he developed an epididymo-orchitis which cleared up under antiluetic treatment. A Wassermann test done at this time showed four plus. Shortly thereafter the patient began to complain of pain along the right ureteral region associated with dysuria. An X-ray examination

ABSCESS OF THE TONGUE.

at this time revealed a ureteral calculus lying in the ureter at its junction with the bladder. The subsequent history of this calculus is not definitely known. Presumably the pain subsided and nothing more was done. With the onset of the present tongue condition, ureteral pain recurred, but this time it was located on the opposite side to that in which the pain had originally been present.

Physical examination showed the tongue markedly swollen, more so on the left side than on the right, and especially toward its root. The surface had a grayish-white coating, which covered it uniformly. Protrusion of the tongue was attended with great pain and was practically impossible. The swelling was indurated and no area of fluctuation was made out at this time. The pharynx was very congested and the pillars of the fauces as well as the soft palate looked cedematous. There was no cervical or submaxillary glandular enlargement. The speech was thick. Otherwise nothing abnormal. Temperature 90.8. Pulse 84.

In view of the history and physical examination a diagnosis of abscess of the tongue was immediately made, with the one reservation, however, that the condition might be a gumma of the tongue. The usual local applications—such as cracked ice to relieve the inflammation and a mouth wash of potassium chlorate to keep the oral cavity clean—were employed. In addition, in view of the luetic history, potassium iodide was given in fifteen grain doses three times daily. The patient was closely watched for possible complications.

Two days later, the patient suddenly developed a chill, the temperature rose to 105.4, the pulse to 130, and he was moderately prostrated. The general physical examination at this time showed no change from the status previously described. Locally, however, there was a definite area of fluctuation to be made out in the centre of the swollen tongue. Anesthesia by nitrous oxide and oxygen. The tongue was dragged out of the mouth as far as possible and after suitable protection of the pharynx to prevent any aspiration of pus, the abscess was first aspirated and then incised. The incision was made on the outer side of the tongue. About two drams of pus were obtained. The cavity resulting easily admitted an average sized thumb and was lined with granulation tissue. It was packed with iodoform gauze. The aspirated pus showed numerous Gram-positive cocci and bacilli. Culture yielded non-hæmolytic streptococci, staphylococci, and diphtheroid organisms.

The subsequent recovery of the patient was slow. Following the removal of the first packing a moderate hemorrhage supervened. This was easily controlled by packing, but on several subsequent occasions the removal of the packing was followed by further hemorrhage. The hemorrhage was finally controlled permanently by removing the packing and suturing the edges of the wound. No untoward effect followed the suture and the wound healed kindly.

To ascertain the cause of the bleeding a section of tissue had been removed from the base of the cavity. Microscopically this showed abundant granulation tissue with numerous dilated blood spaces. No evidence of lues could be demonstrated in the sections, in spite of the fact, that at the time the section was taken, a blood examination showed that the Wassermann reaction was still four plus positive. Antiluetic treatment was instituted. There was no disturbance in the function of the tongue after the wound was healed.

SUMMARY

This was a case of a luetic person in whom after exposure to cold a nasopharyngitis developed. This was complicated by an acute glossitis which went on to suppuration, the abscess being localized to the left and posterior part of the tongue. After appropriate incision and drainage, the wound eventually healed with no untoward result.

Bennet,⁷ in reporting one hundred and forty-five cases found that the incidence of acute glossitis was not confined to adult life, but was equally prevalent at all ages. His youngest patient was nine months old; and his oldest, eighty years.

Butlin⁸ states, however, that the disease is most prone to occur in adults, and more commonly in men than in women. The disease is more often seen during the winter than in summer. In one hundred and fifteen of Bennet's cases the previous health was good. The most common predisposing factors were exposure to cold and wet, as well as to great heat followed by sudden chilling. As a rule, sore throat, tonsillitis, and such diseases as typhoid, erysipelas, variola, and thrush, have all been recorded. Thus, Weiss'⁹ case followed the desquamation of scarlet fever. Washburn¹⁰ and Green¹¹ report a case following sore throat, and Sebrazes, Bonnes and Parsat,¹² scarlatinal sore throat. Erosions within the mouth, ulceration of the cheek, infections of the salivary glands, especially the parotid, pimples of the tongue, infected wounds caused by jagged teeth (occurring sometimes during an epileptiform convulsion), fractures of the lower jaw with fistulae leading into the mouth, burns and scalds of the tongue, local irritation such as occurs from excessive sucking of a pipe, and, as Loeb¹³ reports, the chewing of sticks of pine wood which may have scratched the tongue; all of these form an array of exciting factors recorded from time to time. Recently Raynor¹⁴ reported a case of parenchymatous glossitis following a submucous resection. Incidental factors may be actinomycosis, gout, diabetes, alcoholism and syphilis.

The method of spread is problematical. Thus in the cases following tonsillitis and salivary gland involvement, Combier and Murad¹ believe that the infection travels along the lymphatics which traverse the involved areas, although the exact paths are unknown. They quote Craigin to the effect that the lymphoid tissue disposed at the level of the lingual tonsil may perhaps be the point of dissemination of the infection. The cases due to direct trauma are obviously and more readily understood.

The types of tongue involvement which one sees are either superficial or deep. The superficial, according to Broca, are the usual types of stomatitis. The deep ones are, as a rule, a parenchymatous glossitis which go on to supuration. In several instances the process was a curious form of edema without pus formation. This type corresponds more closely to the one Butlin⁸ calls streptococcal glossitis in which the danger of extension into the neck, lungs, glottis and pericardium exists. On the other hand, the staphylococcus glossitis is characterized most frequently by an acute localized swelling which increases without any marked extension. The swelling is, at first, hard, finally fluctuates, and may burst into the mouth. Mixed infections, especially with streptococci, according to these authors, are most apt to produce multilocular abscesses with extension into the neck.

The pathology, according to Thibaud,⁴ is that of an acute violent inflammation. The vessels are engorged; the entire organ is distended with blood, followed by infiltration, with fibrin and serum into the intermuscular connec-

tive tissue and into the planes of connective tissue separating the muscular fasciculi. There is very little change in the muscular fibres except that due to the pressure of the surrounding parts. Recovery takes place by resolution or suppuration. The suppurative process, unless subjected to early drainage, may extend to the pharynx or larynx. Gangrene may supervene due to the intense swelling, leaving only the stump of the tongue.

The bacteriology is varied as has been mentioned above. Mixed infections are probably more common than have been reported as in our case in which staphylococci, streptococci and diphtheroids and anaërobic bacteria were found. The process may involve the entire tongue or only a portion of it. Thus, of Bennet's series, the entire organ was affected at once in eighty-five, with no suppuration in sixty-six, and abscess in twenty-nine. Of thirty-six cases of hemiglossitis, in twenty it was confined to the left side, eight of which had abscess and twelve not. Of sixteen cases who had a right-sided hemiglossitis four went on to suppuration. From this it is quite evident that the left-sided involvement is most common. Corroborative literature to that effect is to be found in the cases reported by Thomas,¹⁵ Duckworth¹⁶ and Cope-land¹⁷ and others.

In a third form of glossitis—as opposed to the superficial and deep forms referred to previously—the infection occurs first on one and then on the other side; nine such cases are on record.

The onset is, as a rule, acute; occasionally very slow, as in one of the cases of Combiér and Murad, where for several months the patient complained of difficulty in swallowing owing to swelling of the tongue. The prodromal symptoms are characterized by general malaise, the usual chilliness of a cold, or the toxæmia that accompanies a sore throat. In a general way, the antecedent infection stamps the character of the onset. The fever varies from 99.8 F. to 104 F. Occasionally there is no fever. Our cases had 99.2 F., even though there was marked involvement of the tongue.

The attack, on the other hand, may be initiated by a sudden chill, high temperature, marked general discomfort, flushed cheeks, difficulty on swallowing and salivation. The accompanying pain may be referred to the jaws and occasionally to the ears, the latter because of involvement of the chorda tympani nerve. Associated with such symptoms, the swelling of the tongue increases rapidly until the entire oral cavity is filled. Protrusion of the tongue is agonizing, as well as any movement of the organ. Speech is interfered with as is the breathing at times. The surface may be covered with a dark brownish membrane, but at times the fur is dark gray. On palpation, the swelling is uniformly hard, or, in the presence of suppuration, focally fluctuant.

The diagnosis is usually obvious. Conditions, however, which bring about secondary swelling of the tongue may give rise to controversy from time to time. Thus, salivary calculi, acute ranula, herpes of the mouth, lips, tongue, and pharynx have been stressed by Mackenzie as giving rise to confusion in the diagnosis.

The differential diagnosis in the first of these is made by finding and expelling the calculus, following which there is prompt subsidence of the tongue swelling. In ranula, the swelling is mostly confined to the floor of the mouth. In connection with herpetiform eruptions, the obviousness of the latter forms an easy point of distinction. In the opinion of Bennet all of these conditions bring about an acute true glossitis which is a complicating factor of the primary condition.

In discussing the types of glossitis, mention has been made of the grave possibilities which may accompany streptococcal glossitis. In addition to the general septicæmic character of the complication, local dangerous phenomena, which render the prognosis rather doubtful, should always be borne in mind. Impending suffocation due to the extreme swelling, rupture of the abscess with the opening of a vein and resulting hemorrhage, spread of the infection into the submental connective tissue with a consequent Ludwig's angina, extension to the peritonsillar or post-pharyngeal region, pulmonary or mediastinal structures, are ominous possibilities.

In Bennet's series of one hundred and forty-five cases, the mortality was three per cent. This can possibly still be lowered by prompt surgical intervention.

The treatment is of course simple. Antiseptic mouth washes are indicated until a focus of liquefaction is discernible. Then prompt incision and drainage is necessary. Incision on the lateral aspect of the tongue, as was practised in the case reported by us, seems preferable. Owing to the muscular structure, this permits a more rapid agglutination of the surfaces after the packing is removed; and if any complication, such as hemorrhage, arise, it can more easily be controlled by suture.

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INTERCOSTAL THORACOPUNCTURE FOR THE REMOVAL OF PENETRATING PROJECTILES IN THE LUNG*

BY CHEVALIER JACKSON, M.D.

OF PHILADELPHIA, PA.

Aspirated Foreign Bodies.—All foreign bodies that have reached the lung by the natural passages can be removed by bronchoscopy through the mouth, with ultimate recovery in about 98 per cent. of the cases.

Penetrating projectiles lodged in the middle or either lower lobe can also be removed by bronchoscopy through the mouth, if the projectile is not too large in its transverse diameter to permit its lengthwise withdrawal through the main bronchus. Foreign bodies that have penetrated the *mediastinum* can be removed by the bronchoscope or œsophagoscope, but the advisability of doing so is open to question. In one such case I deemed such removal inadvisable because the location of the foreign body below the heart would involve grave risk of rupture of the pericardium, owing to the angle of approach through the mouth. It was removed by Dr. Thomas W. Shallow, approaching through the ribs by thoracotomy with a perfect result. Penetrating projectiles lodged in the upper lobes, unless in a bronchus, are not readily removable by peroral bronchoscopy.

Thoracopuncture for Penetrating Projectiles.—Penetrating projectiles in any portion of either lung can, I think, be removed by intercostal thoracopuncture without rib-resection, and in certain cases without pneumothorax, hæmothorax, lung-suppurative or other complication; but the advisability of the procedure in a given case will doubtless depend upon the size and location of the intruder and upon the presence or absence of suppuration requiring external drainage. A large series of cases will be necessary to make clear the indications and contraindications of thoracopuncture; but as to its feasibility there can be no question.

By thoracopuncture is meant the intercostal penetration of the thorax by a special forceps (thoracopunctator) inserted through the skin, pleura and pulmonary tissue, the instrument fitting its own track so tightly as to avoid open pneumothorax.

The following report of a case has no bearing on the question of advisability of removal of penetrating, non-suppurative projectiles imbedded in the parenchyma of the lung, except insofar as the simplicity, ease and harmlessness (in certain cases) of the method used may outweigh the considerations as

* Case presentation, by invitation, at the meeting of the Philadelphia Academy of Surgery, April 2, 1923.

to the possible harmlessness of leaving the foreign body alone. The report is made simply to illustrate the fact that thoracopuncture can be, in a suitable case, a relatively minor procedure.

Case Report.—No. Fbly. 1131. Ex-private U. S. Army, age twenty-seven years, wounded in action in France on August 28, 1918, a number of fragments of shrapnel penetrating the chest, from which there was free bleeding; no hæmoptysis. Evacuated to Base Hospital where a number of fragments of shell were removed. Transferred to Base at Paris, then to U. S.; all wounds healed

March 3, 1919.

Three years after healing a small pustule appeared in the scar. Ray study showed a fragment of metallic foreign body in upper lobe of left lung. Thoracotomy was done in a civil hospital but fragment could not be located. Admitted to League Island Naval Hospital with wound cavity discharging freely. Doctor Pillmore located the foreign body in the parenchyma of the left upper lobe (Fig. 1). Dr. Willis F. Manges found that there was no fistula leading

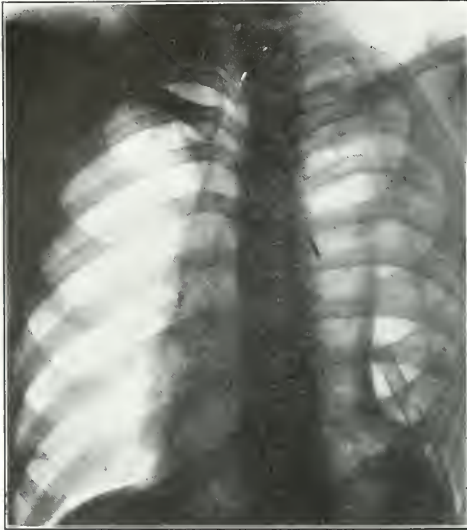


FIG. 1.—Röntgenogram showing shell fragment in left lung. (Film by Dr. Pillmore.)

from the fragment of shell to the wound cavity. In consultations with the Commanding Officer, Dr. Raymond Spears and Dr. J. Chalmers DaCosta it was decided that the fragment should be removed, for which the patient was referred to the Bronchoscopic Clinic. Lung-mapping by bronchoscopic bismuth subnitrate insufflation by the author's method[†] showed (Fig. 2) that the fragment was inaccessible by peroral bronchoscopy because of its location too far "around the corner," from the main bronchus, in the upper left lobe; whereas it would be readily accessible through the peripheral lung-tissue at a depth of about 4 cm.

The lung-mapping gave us the location of the large vessels which bear more or less constant relation to the tracheobronchial tree.

In collaboration with Dr. Willis F. Manges the thoracopunctator (Fig. 3)

[†] Jackson, Chevalier. The Bronchial Tree, Its study by Insufflation of Opaque Substances in the Living. Amer. Journ. Ront., October, 1918, p. 454.

was devised. The parallel sides were designed to prevent leakage of air or blood past the instrument at least before the completion of the seizure and withdrawal of the foreign body. The point was designed to push aside rather than penetrate large vessels. As suggested by Dr. Thomas Shallow, if the pleura should prove too thick for penetration a puncture with a very slender tenotome would give the penetrator a start. The possible dangers considered were: 1, open pneumothorax; 2, hemorrhage with its associated risks of shock, hæmomediastinum, hæmothorax, infected hæmothorax, intrabronchial leakage and hæmorrhage, especially from the pulmonary artery, which Dr. J. Parsons Schaffer determined to be within one centimetre of the shell fragment; 3, opening into the external suppurating cavity which did not previously communicate with the foreign body; 4, laceration of the pericardium which lay close posteriorly. All of these dangers were considered as almost negligible in view of a special technic planned to avoid or minimize the seriousness of all of them. Open pneumothorax was deemed an impossible result with the form of blunt penetrating forceps (thoracopunctator) designed (Fig. 3) because the parallel sides of its shaft would occlude its own opening during the work, and the blunt conical wedge-shaped point would push aside and stretch the tissue the elasticity of which would close the wound of penetration after the withdrawal of the forceps and foreign body, which latter was to be withdrawn lengthwise, not crosswise. Because of the location of the foreign body close to the pericardium, the pulmonary artery and the root of the lung it was thought the procedure would call for the utmost care and precision in the penetration, seizure and removal of the foreign body so as to limit the wound of penetration to the track made by the forceps, which track was planned to avoid the internal mammary artery. The utmost care would be necessary to avoid penetration or laceration beyond the foreign body as the pulmonary artery was only 1 cm. deeper than the foreign body in the prolongation of the designed direction of approach.



FIG. 2.—Lung-mapping with bronchoscopically insufflated bismuth subcarbonate, showing the relation of the projectile to the tracheobronchial tree. (Film by Dr. Willis F. Manges.)

Precautions against Hemorrhage. From past experience the author has reached the conclusions that the best method of combating hœmorrhage in severe traumatic pulmonary hemorrhage involving a bronchus is by "casing off" the bleeding lung with a large bronchoscope which at the same time "pipes" air down into the sound lung. Any blood that might leak past the "casing" bronchoscope is automatically removed through the aspirating canal; clots are wiped out with bronchoscopic sponges. Oxygen is supplied through the insufflation of the

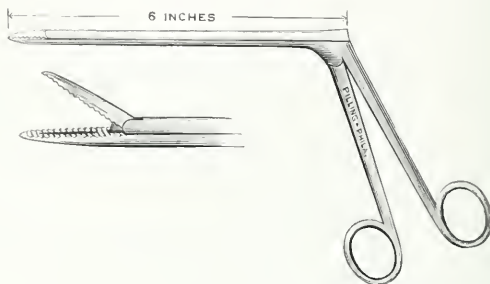


FIG. 3.—Thoracopunctator with parallel sides, as suggested by Dr. Manges to prevent leakage of air past it into the pleural cavity. Prevention of collapse greatly facilitates reaching and grasping the projectile under fluoroscopic guidance. The point is designed to push aside rather than penetrate large vessels or bronchi.

bronchoscope, if the patient is breathing; if not, through the independent tube. It is necessary that the bronchoscope fit snugly in the bronchus so as not to leave room for the leakage of much blood between the bronchoscope and the bronchial wall. In an adult the 9 mm. aspirating bronchoscope is the proper size. For casing off a bleeding lung the bronchoscope must not have the side-holes ordinarily placed in the wall for collateral respiration, because too much blood would leak through the holes. An œsophagoscope of proper size will serve the purpose. The

9 mm. would be the right size for an adult; and the "full lumen" model would be best, though the standard model would answer in an emergency. Avoidance of anesthesia leaves all of the natural agencies of life-preservation unimpaired, therefore we decided against general anesthesia, which moreover seemed unnecessary; but the method of casing off the operated lung and piping the sound lung is equally adapted to any thoracic operation under general anesthesia.

Thoracopuncture.—Dr. Gabriel Tucker applied a little cocaine solution to the interior of the larynx. Dr. Louis H. Clerf quickly and skillfully introduced a 9 mm. bronchoscope (without side openings) into the right bronchus. Local



FIG. 4.—Fragment of shrapnel removed through the chest wall by the thoracopuncture.

anesthesia along the track of the planned thoracopuncture was obtained by injection of the skin and the region of the intercostal nerves with novocain solution and a few drops of a 4 per cent. cocaine solution in the pleura. This was done so skillfully by Doctor Shallow that the patient never felt any severe pain and remained motionless throughout the procedure. Through a tiny puncture in the skin in the third interspace, one centimetre to the left of the vertical dotted location, we inserted the thoracopunctator using strong friction of the left hand to hold back the instrument and prevent its plunging. Doctor Manges with his

double-plane fluoroscope gave me such accurate guidance that I was able to go directly to the shell-fragment, then open the jaws of the penetrator, seize the lower extremity of the fragment, rotate it so that its long diameter corresponded to that of the track of thoracopuncture and withdraw it without a single false grasp or false movement, thus causing no unnecessary trauma. A dressing was placed over the puncture.

Progress.—There was no expectoration, pain, hæmoptysis, hæmothorax, pneumothorax, or any other complication. The temperature was 100° F. the following day but came to normal the next morning and did not rise again. The patient was out of bed on the third day and going about the ward. This man was presented before the Philadelphia Academy of Surgery at its meeting of April 2, 1923, see page 537. A tiny scar at the site of puncture is the only trace of the operation. (Fig. 5). Ray examination by Doctor Manges shows no trace of the track of thoracopuncture.

CONCLUSIONS

1. In lung mapping by the author's method of bronchoscopic insufflation of bismuth subnitrate we have a harmless and efficient aid in the study and localization of penetrating foreign bodies and their secondary pathology.

2. In "casing off" the operative lung and "piping" the sound lung with a close fitting bronchoscope introduced through the mouth we have a safeguard in thoracic operative procedures, inasmuch as the absolute control over the sound lung enables the bronchoscopic assistant to prevent blood entering the sound lung and to maintain ventilation indefinitely whether the patient's breathing movements are suspended or not.‡

3. Thoracopuncture, carefully done, with necessary precautions, in suitable cases, seems such a minor procedure compared to extensive rib-resection that

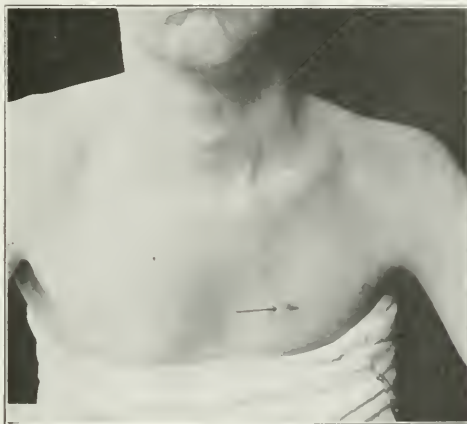


FIG. 5.—Photograph of patient showing site of puncture. The scar was so tiny as not to show on a photograph; therefore a dart is used to indicate it.

‡Gaub, O. C., and Jackson, C.: Bronchoscopic Aid in Thoracotomy. The Laryngoscope, February, 1910. See also Bronchoscopic Oxygen Insufflation in Bronchoscopy and Oesophagoscopy, by Chevalier Jackson, 1923, (text-book, W. B. Saunders Co.), page 71. Also in Peroral Endoscopy and Laryngeal Surgery, Chevalier Jackson, Text-book, p. 73 *et seq.*

it promises to modify the adverse opinion held by some surgeons as to the immediate presuppurative removal of small penetrating shell fragments, bullets and other penetrating projectiles lodged in the lung.

4. I feel sure that any small penetrating projectile not located near the root of the lung can be removed by thoracopuncture under local anaesthesia and leave the patient in better condition than if the projectile had gone clear through and emerged without touching a bone or large vessel. I feel sure that any clothing cap would be brought away with the projectile, but there was no fabric in the case herewith reported.

5. Intercostal removal, of course, has the fixed limitation of the maximum available size of the intercostal space. Larger projectiles would require rib-resection. Even in such cases, the thoracopunctator has the great advantage of penetrating the lungs without admitting air to the pleural cavity. Reaching and grasping the projectile under the fluoroscopic guidance are greatly facilitated by the uncollapsed state of the lung. After the intruder is grasped and brought to the ribs, resection may be done, while the projectile is held in the thoracopunctator. If the intruder is known beforehand to be too large for intercostal removal, the rib-section may be done first, care being taken not to make a leak through the parietal pleura. The thoracopunctator will then go in with an airtight fit.

6. Thoracopuncture can easily be a very dangerous and rapidly fatal procedure unless the utmost caution is observed in its planning and performance, and in preparedness for possible emergencies. Clawing around in the lung is unnecessary and dangerous. The thoracopunctator can be, I think, inserted, closed, in a safe track, until contact is made with the foreign body; then the jaws can be opened, intruder seized without a single false move and withdrawn through the track of entrance. This track is planned beforehand so that the approach will be through parenchymal lung tissue. Thoracopuncture should not be attempted except by, or with the coöperation of, the thoracic surgeon. The coöperation of an expert röntgenologist with the Manges double plane fluoroscope is essential for safety as well as success both in the planning and the execution of the procedure. It seems advisable to limit its use to penetrating foreign bodies in the periphery of the lung, avoiding the location of large vessels and the root structures.

7. Thoracopuncture is not advised for the removal of foreign bodies that have reached the lung through the natural passages, 90 per cent. of which can be removed through the mouth.

RESECTION OF STOMACH FOR CHRONIC GASTRIC AND DUODENAL ULCER*

BY RICHARD LEWISOHN, M.D.

OF NEW YORK, N. Y.

GASTRO-ENTEROSTOMY has been a well-established procedure in the surgical treatment of gastric and duodenal ulcers for the past thirty years. The first gastro-enterostomy for ulcer of the stomach was performed by Doyen in 1893.

For more than two decades following its introduction as a side-tracking, indirectly curative procedure for ulcer of the stomach, gastro-enterostomy, with or without pyloric exclusion, was considered as the method of choice. Plastic operative procedures on the pylorus (Heinecke-Mikulicz, Finney, etc.) have acquired some popularity. However, it is safe to say that up to recent years, gastro-enterostomy was considered the ideal operative procedure irrespective of what part of the stomach or duodenum was involved.

Enthusiasm for this simple procedure, however, is not as uniform as it used to be ten years ago. Many surgeons still claim that permanent cures of gastric and duodenal ulcers follow simple gastro-enterostomy in practically all cases. In recent years this procedure has fallen somewhat into disfavor. Whereas some clinics, even as recently as 1921, have published statistics with over 90 per cent. cures, other clinics have had much less favorable results, some of them reporting cures following gastro-enterostomy in not more than about 70 per cent.

That gastro-enterostomy does not give ideal permanent results is evident from the fact that many physicians hesitate to turn over their patients suffering from non-obstructing gastric or duodenal ulcers to the surgeon for a gastro-enterostomy. They claim that many of the patients thus treated are only slightly improved and that in some cases the condition is much worse than before the operation. The physician naturally reflects the voice of his patients. Evidently many patients suffering from gastric or duodenal ulcers are not cured following a simple gastro-enterostomy.

I do not want to enter here into a discussion of the different reasons why gastro-enterostomy may fail to effect a cure. The literature is full of different suggestions (place and size of the stoma, choice of suture material, improper medical after-treatment, etc.). The most dreaded complication following gastro-enterostomy is a subsequent gastrojejunal ulcer. Statistics as to the frequency of its occurrence differ widely. However, 3 to 5 per cent. seems to be a rather conservative estimate. It is a well-known fact that surgical treatment of gastrojejunal ulcers with adhesions to or perforations into the colon is a most difficult problem. Furthermore some patients have

* Read before the New York Surgical Society, April 11, 1923.

suffered from repeated recurrence of this condition, requiring three and more operations. In a paper on this subject,¹ published two years ago, I reported a case operated upon three times for this condition (two gastrojejunal ulcers and one jejunal ulcer). This patient, who has been perfectly well for the past two years, had to undergo four operations within a period of six years to obtain a more or less permanent cure. The pains caused by gastrojejunal ulcers are very severe, much worse than those caused by gastric or duodenal ulcers. These patients are worse off than they were before the gastro-

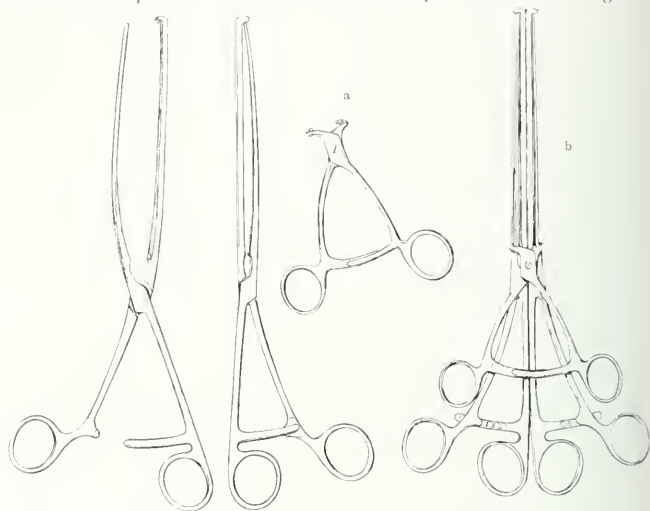


FIG. 1.—Maier Clamp. (a) Parts comprising clamp. (b) Clamp closed.

enterostomy. Besides their suffering, they face the possibility of perforation or hemorrhage.

The fact that simple gastro-enterostomy will fail to cure penetrating ulcers of the lesser curvature of the stomach has been recognized for some years. Gastro-enterostomy was gradually replaced by excision, either with knife or cautery (Balfour), resection of the lesser curvature (Schmieden), sleeve resection or partial gastrectomy. In very large ulcers, occupying practically the whole posterior wall of the stomach, jejunostomy may be preferable to subtotal gastrectomy.

There is one form of penetrating ulcer which ought to be treated with local excision, namely, the ulcer situated close to the cardia. However, it must be stated that in ulcers so situated even local excision is not entirely safe.

Resection of pyloric and duodenal ulcers, except those easily amenable to excision, was not attempted until lately. Haberer² showed that radical removal of practically every ulcer, even those adherent to pancreas or liver,

is not only feasible, but that the mortality connected with these rather extensive operations can be very small.

Haberer's purpose in radical removal of pyloric and duodenal ulcers, which includes a resection of the antral portion of the stomach, is two-fold: First, to remove the ulcer and prevent later complications (perforation, hemorrhage, malignant degeneration), and secondly, to remove the antrum and the acid factory of the stomach and thus reduce the possibilities of the recurrence of an ulcer.

What is meant by acid factory of the stomach? The acid-producing glands of the stomach are situated in the fundus. However, the antrum produces a hormone which stimulates the acid glands. In other words, the antrum contains the motor which starts the machinery of acid production. This area extends to about 8 or 10 cm. from the pylorus. By removing pylorus and antrum the possibility of recurrent ulcers is greatly reduced.

Pyloric exclusion seems to be a factor in the production of gastrojejunal ulcers. Haberer encountered eleven marginal ulcers among seventy-one cases of Eiselsberg exclusion. It is not probable that other simpler forms of exclusion will give so high a percentage of gastrojejunal ulcers. This question is now under investigation in a large series of patients in whom exclusions were performed according to Berg's method.

The resection of the stomach can be performed in two ways, either by the Billroth I or by the Billroth II method. I think it is wise not to practice one procedure to the exclusion of the other, but to select the method according to the individual case.

When the duodenum is freely movable, Billroth I represents the ideal procedure, because this method reestablishes normal conditions. Antrum,

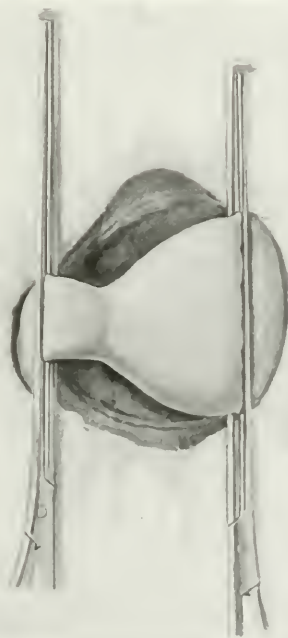


FIG. 1. Billroth I

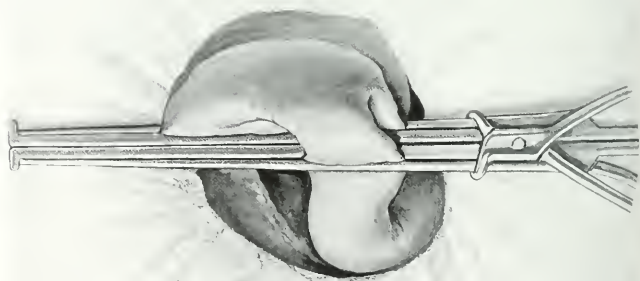


FIG. 3. Serosa pouch, to be locked by ethyl ether.

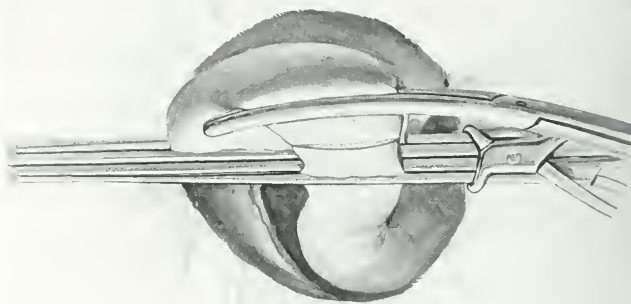


FIG. 4. Serosa pouch, to be locked by ethyl ether.

pylorus and the ulcer (whether gastric or duodenal) are removed en bloc and both ends are reunited.

The vast majority of the duodenal ulcers are situated in the first part of the duodenum. Simple palpation of the ulcer without proper freeing of the duodenum often gives the false impression that these ulcers are situated in the second portion of the duodenum.

However, after liberating periduodenal adhesions and splitting the peritoneum on the outer aspect of the duodenum, these ulcers are found to be in the first portion of the duodenum and as such can be resected en bloc with pylorus and antrum.

Adhesions of the ulcer to the pancreas are no contra-indication to radical procedure. Haberer has demonstrated that one may easily deal with these adhesions either by the cautery or by splitting the capsule of the pancreas. It was formerly assumed that such radical procedures would cause fat necrosis.

The incorrectness of this view has been shown by the great number of cases so treated during the past few years. In fact, even after resection of the pancreas fat necrosis is not encountered when the defect in the capsule has been properly sutured.

If we want to perform a Billroth I resection, we have to free the stomach as well as the duodenum from the attachments, in order to be able to anastomose without tension. After proper freeing of stomach and duodenum, it is remarkable how easily the resected ends can be brought together, even though more than half of the stomach be removed. Haberer reports a case in which he did such extensive resection that he had to perform the Billroth I anastomosis under the left border of the ribs. In other words, he had to

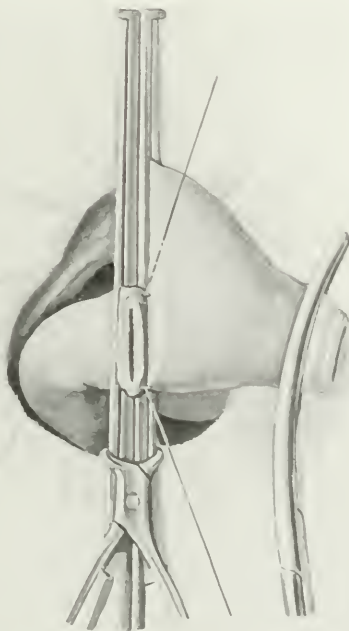


FIG. 2. — Stomach and duodenum, showing the Billroth I resection.

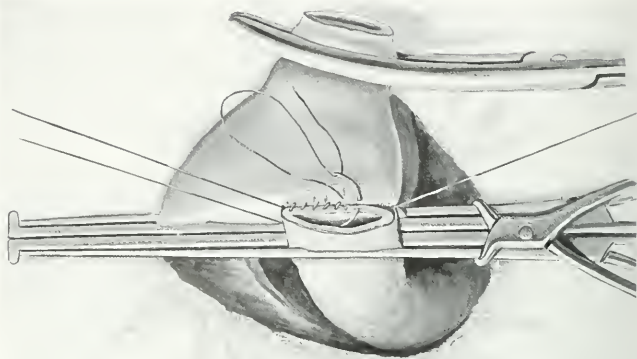


Fig. 5. Posterior, continuous sero-muscular suture applied.

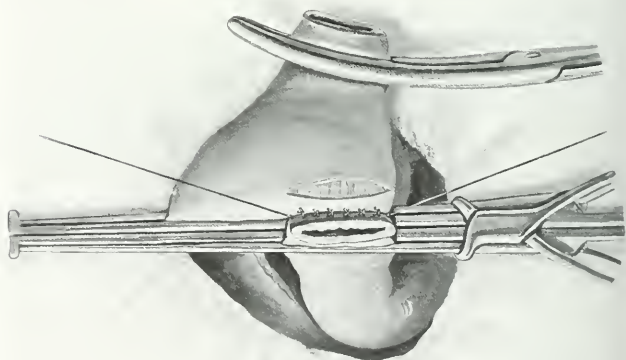


Fig. 6. Interrupted silk suture applied and serosa on the posterior surface of the uterus closed.

lift the duodenum over to the left hypochondrium. A perfect result was obtained.

When the ulcer is situated at the posterior wall of the duodenum, or so low that direct anastomosis between stomach and duodenum is not safe, we can either perform a Billroth II or use Haberer's³ method of gastro-duodenostomy (a modified Kocher). Since the post-operative course following a Billroth II is smoother than that following a gastro-duodenostomy, closure of both ends followed by a gastro-enterostomy is preferable.

Haberer's modification of the Billroth I technic is demonstrated in the accompanying pictures. The clamp shown in these pictures was constructed by Maier (Innsbruck). This clamp provides for excellent approximation of stomach and duodenum during the process of suture (Fig. 1). A similar clamp was constructed by Lane.

After proper liberation of the area to be resected the two clamps are applied (Fig. 2) and the clamp is then closed (Fig. 3). The duodenal serosa is cut on its anterior aspect (Fig. 4). The duodenum is then cut through and two silk guides fit the upper and lower angle of the duodenum (serosal stitch) to the posterior wall of the stomach (Fig. 5). A

row of interrupted silk sutures is placed between these two guides and the serosa of the posterior wall of the stomach is cut. The length of this incision varies according to the size of the duodenum (Fig. 6). A running muscularis-serosal stitch is then placed in front of the interrupted silk sutures, both ends of this stitch being left long (Fig. 7). The gastric serosa is now incised for the whole circumference of the stomach. A clamp is applied on the gastric side and the stomach divided, thus removing that portion of stomach and duodenum to be resected (Fig. 8). The upper lumen of the stomach is closed with a

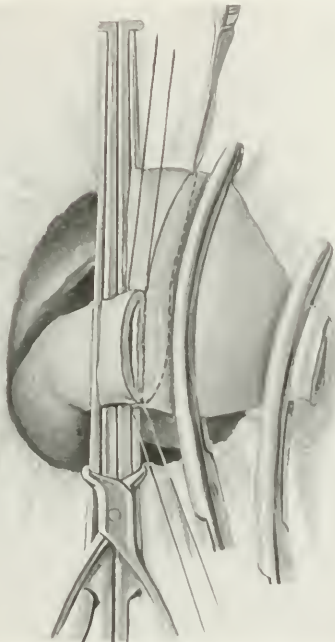


FIG. 8.—Showing line of resection of remaining portion of the stomach.

through-and-through catgut suture (Fig. 9). A running mucosal stitch closes the lumen of stomach and duodenum at the site of the anastomosis (Fig. 10). This suture line is covered anteriorly by a running muscularis-serosal stitch. Both clamps are then removed (Fig. 11). The suture line at the upper end of the stomach is then buried with a series of interrupted stitches (Fig. 12). A silk suture, taking in anterior and posterior walls of the stomach and upper border of the duodenum, is then placed at the upper end of the anastomosis

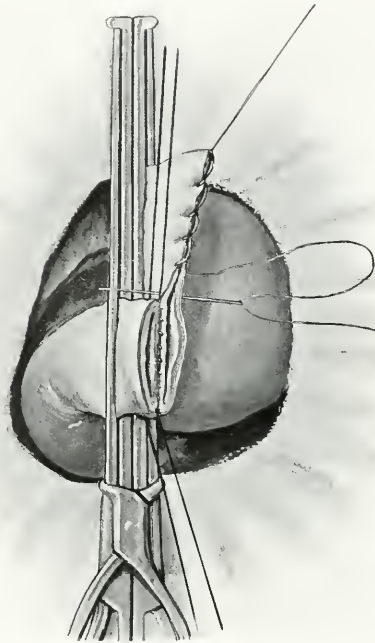


FIG. 9.—Closure of portion of stomach above point of anastomosis.

and tied with the silk guide which was left in place. It is very important to close in this angle (so-called "Jammerecke") in order to prevent leakage. The silk suture is then carried as a running suture along the anterior wall of the anastomosis and united with the silk guide at the lower angle of the anastomosis (Fig. 13).

It is very important that small needles and fine suture material are used for the anastomosis. The mucosa must be united in such a fashion that no pocketing occurs. The Connell stitch

should not be used for the direct anastomosis of stomach and duodenum as it causes protrusion of tissue into the lumen with secondary stenosis and retention. The technic described above might be simplified, if the stomach were resected immediately after the clamps are applied.

If the Billroth II method is used, it is advisable to cut through the stomach between two clamps immediately after ligation of the vessels. The proximal part of the stomach is covered with iodoform gauze. The distal part, also so protected, is brought over to the right, thus exposing the posterior wall

of the stomach, the pancreas, and the median colic vessels. Adhesions, so frequent in this region, can then be dealt with under the guidance of the eye. The sharp dissection of the duodenal ulcer from the pancreas is made much easier by pulling stomach, pylorus and duodenum to the right. This procedure brings the periduodenal adhesions into excellent view.

After proper liberation below the level of the ulcer, the duodenum is resected and the lumen closed with a Connell stitch. For the second and third rows of sutures we usually have to use the capsule of the pancreas which provides excellent material for a proper closure of the duodenum. The proximal end of the stomach is then closed in three layers.

A number of different methods are at our disposal for the re-anastomosis of stomach and intestine. Posterior suture gastro-enterostomy gives very excellent results. If a subtotal gastrectomy has been performed, the Murphy button may be used. Before closing the gastric end one-half of a Murphy button is dropped into the remnant of the stomach, the other part of the button is inserted into the jejunum in typical fashion and a very small stab is then made into the posterior wall of the stomach. The gastric half of the button is pushed through this opening and stomach and jejunum are thus united.

A. A. Berg has used the long loop anterior antecolic gastro-enterostomy without entero-anastomosis in a large number of cases of partial or subtotal gastrectomies with excellent results. It seems unnecessary to add Braun's anastomosis, when performing an anterior gastro-enterostomy after resection of the stomach. While vicious circle may occur with open pylorus, this complication seems to be very rare after partial gastrectomy.

Other methods applicable for the gastro-enteric anastomosis are the Polya-Balfour method and Moynihan's modification of the Roux anastomosis.

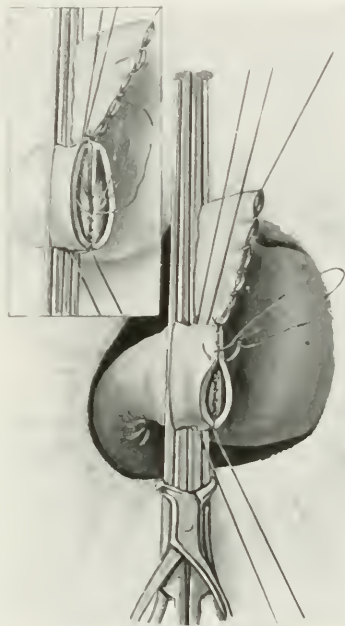


FIG. 10.—Suture of m. pylor. Insert shows posterior suture line

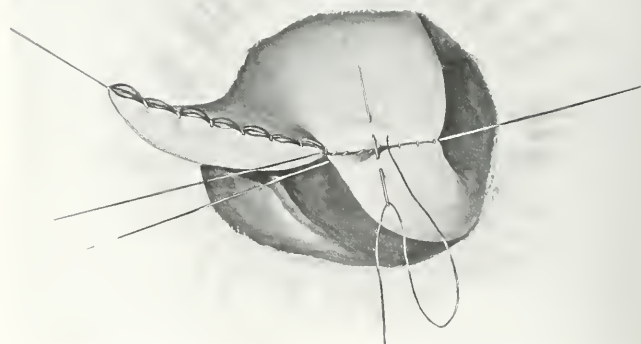


FIG. 11. Anterior sero-muscular suture.

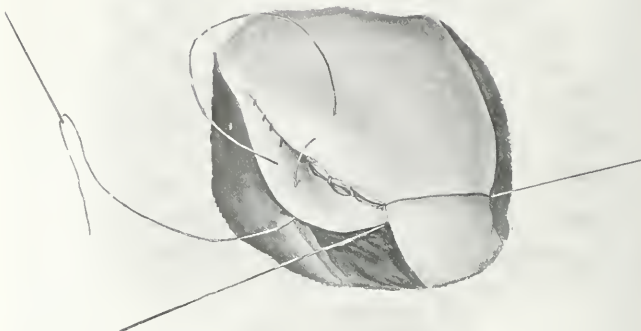


FIG. 12. Interrupted silk suture infolding upper portion of the stomach and reconstructing lesser curvature.

RESECTION OF STOMACH FOR ULCER

The question may be raised as to the necessity of such extensive procedures in view of the fact that the final step is a gastro-enterostomy. However, resection plus gastro-enterostomy seems to offer a much more favorable outlook for permanent cure than simple gastro-enterostomy or gastro-enterostomy with pyloric exclusion. With this more radical procedure we not only remove the ulcer, but minimize the possibility of gastrojejunal ulcers. It is a well-known fact that gastrojejunal ulcers are extremely rare following a resection of antrum and pylorus. Patients thus treated feel perfectly well and remain well. I have never seen a gastrojejunal ulcer following a partial

TABLE I.

Table Showing Acid Values Before and After Resection of the Stomach.

Case	Operation.	Before operation.		After operation, March, 1923.	
		Free HCl.	Total acidity.	Free HCl.	Total acidity.
1	1920	57	70	12	28
2	1920	20	60	0	16
3	1921	8	54	0	36
5	1922	not taken	not taken	0	17
6	1922	50	70	0	16
8	1922	39	64	9	25
9	1923	60	80	0	30
10	1923	32	64	5	12
11	1923	86	100	28	76
12	1923	56	84	0	24

gastrectomy. I have, however, observed a case of gastrojejunal ulcer following simple pylorectomy.¹

Following simple gastro-enterostomy acid values of the gastric contents are usually not changed materially. The regurgitation of the bile is supposed to reduce hyperacidity, but fails to do so in the vast majority of instances. Lorenz and Schur have recently published a paper, showing the marked diminution of acid values following resection of the stomach. I am studying this question at present by comparing the gastric contents of resections with those following simple gastro-enterostomy. This question now under investigation will be the subject of a subsequent communication.

I would like here to quote briefly some figures obtained with Ewald test-meals before and after the operation in my cases of resection for gastric and duodenal ulcers reported below. The table shows that following resection of the stomach free acid disappears entirely in the majority of cases and does not return even after long intervals. (Table I.)

My personal experience with resection in gastric and duodenal ulcers comprises twelve cases with one death (mortality 8 per cent.). Ten patients are perfectly well at present, the interval since the operations varying from two months to three years. One patient (Case IV: partial gastrectomy with button gastro-enterostomy) returned to us eight months after the operation suffering from a stenosis of the stoma, as sometimes seen following

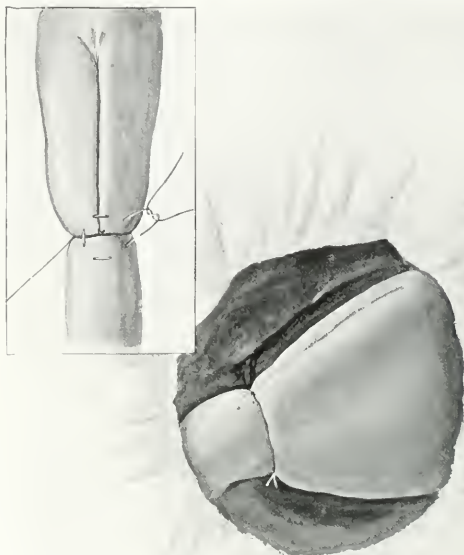


FIG. 13.—Continuous silk suture completing the anastomosis. Insert shows method of reinforcing upper angle of anastomosis.

the use of a Murphy button.⁵ He refused reoperation. Eight patients were suffering from penetrating ulcers of the lesser curvature, four from pyloric and duodenal ulcers. Billroth II was performed in ten cases, Billroth I in two cases. The operative recovery was remarkably smooth, much smoother than in many cases of gastro-enterostomy. The Murphy button was used in the first six cases. In one of these the button fell into the stomach and had to be removed by subsequent gastrotomy.

I am well aware of the fact that the number of my cases is very small. The question of the usefulness of a method can only be settled by a large

series of cases. Such series have been published by Haberer and Friedemann. Haberer⁶ has performed Billroth I for gastric and duodenal ulcers in two hundred and fifty-six cases with 5 per cent. mortality and Friedemann⁴ reports one hundred and fifteen Billroth I with 2.6 per cent. mortality. These figures compare very favorably with mortality following gastro-enterostomy (Peck,² 10 per cent.; Pool,³ 7 per cent.; Scudder,⁵ 6 per cent.).

The question of anesthesia is very important. In debilitated patients an attempt should be made to get along without a general anesthetic. With the proper coöperation of the patient thorough infiltration of the abdominal wall is often sufficient to allow the resection, though the first steps (ligation of the vessels and division of adhesions) are often very painful. Avoidance of a general anesthetic reduces the possibility of post-operative pneumonia. However, some patients are severely shocked following a resection without a general anesthetic. This method of anesthesia (as used by Haberer and others) is erroneously called: local anesthesia. It should be called: anesthesia of the abdominal wall. With the exception of the abdominal wall the operative field is not anesthetized. In fact, the major part of the operation is performed without any anesthesia whatever.

Lumbar or splanchnic anesthesia are too risky to make them commendable for gastric resections. Local infiltration of the operative field (lesser omentum, gastro-colic ligament, etc.) obscures the landmarks and makes resection much more difficult. If a general anesthetic is used, gas and ether, given by an expert anesthetist, is preferable. A general anesthetic was given in the cases reported below, except in Case VII, which was performed following an anesthesia of the abdominal wall, without causing much pain to the patient.

I have left untouched the question of pre-operative and post-operative management of the patient, but it does not differ much from that used in other abdominal operations.

It is too early to state definitely whether this radical procedure should be used extensively in the surgical treatment of pyloric and duodenal ulcers. A very large experience has to be gathered in different surgical centres, before this question can be definitely settled.

It is very probable that even following resection occasional recurrences may occur. In fact, single instances of recurrence following the Billroth I, as well as the Billroth II resection, have been reported.

This more radical attack of gastric and duodenal ulcers certainly offers a very favorable outlook. Gastric resection not only removes the ulcers radically, but in the vast majority of cases it seems to effect a permanent cure.

CASE REPORTS

CASE I—D. W., twenty-three, male. Admitted to Mount Sinai Hospital, March 4, 1920. Discharged April 4, 1920. *Diagnosis:* Penetrating gastric ulcer lesser curvature of stomach. *Operation:* Partial gastrectomy (Billroth II); Button gastro-enterostomy.

History: Patient has had epigastric distress with typical hunger pain for the

last five years. Marked intermission of symptoms. X-ray examination shows large penetrating ulcer of lesser curvature of the stomach.

Operation: Subtotal gastrectomy for penetrating ulcer adherent to the pancreas; button gastrojejunostomy. The vessels were ligated. Stomach freed posteriorly by cutting through base of ulcer, leaving it attached to pancreas. The stomach was then liberated beyond the pylorus and resected; both proximal and distal ends closed in three layers. Button gastrojejunostomy was performed. *Microscopic Examination:* Benign ulcer with inflammatory glands. Uneventful recovery. Reexamination March, 1923: Patient feels perfectly well.

CASE II.—H. S., fifty-five, male. Admitted to Mount Sinai Hospital, October 24, 1920. Discharged November 12, 1920. *Diagnosis:* Penetrating gastric ulcer lesser curvature of stomach. *Operation:* Subtotal gastrectomy; button gastrojejunostomy.

History: Epigastric distress for one month; no vomiting; frequent eructations. For last week pain has been very severe. X-ray examination shows a large penetrating ulcer at the reentrant angle.

Operation: Subtotal gastrectomy for penetrating ulcer lesser curvature; button gastrojejunostomy. *Findings:* Large indurated ulcer about two inches in diameter, not adherent to the pancreas. Procedure: Ligation of vessels and freeing of adhesions. Stomach divided proximally to the ulcer and about one inch beyond the pylorus. Closure of both ends in three layers. Button gastro-enterostomy. Specimen shows a large callous ulcer, size of 50-cent piece, with sharp edges; surrounding tissues were very much indurated. Uneventful recovery. March, 1923. Patient feels perfectly well.

CASE III.—M. C., twenty-eight, male. Admitted to Mount Sinai Hospital, June 20, 1921. Discharged July 16, 1921. *Diagnosis:* Penetrating ulcer, lesser curvature of stomach. *Operation:* Partial gastrectomy; posterior button gastro-enterostomy.

History: Patient has had attacks of severe epigastric pains for the last ten years; no vomiting. Eight years ago exploratory laparotomy was done at another hospital; no abnormality was found in the stomach; the appendix was removed. X-ray examination shows a slight delay in motility; no defect in the stomach or at the duodenal cap.

Operation: Partial gastrectomy; button gastro-enterostomy for penetrating ulcer. *Findings:* Large indurated ulcer on the lesser curvature not adherent posteriorly. Typical gastrectomy and button gastro-enterostomy was performed. *Microscopic Examination:* Simple ulcer. Uneventful recovery. Reexamination, March, 1923: Patient has gained twenty-three pounds since operation.

CASE IV.—J. F., thirty-eight, male. Admitted to Mount Sinai Hospital, October 3, 1921. Discharged October 19, 1921. *Diagnosis:* Penetrating ulcer lesser curvature of stomach. *Operation:* Partial gastrectomy; button gastro-enterostomy.

History: Radiating pains in upper abdomen one hour after meals for last two months; pain lasts about one hour; no vomiting; marked constipation. X-ray examination shows penetrating ulcer lesser curvature of the stomach.

Operation: Findings: Penetrating ulcer of the lesser curvature of the reentrant angle. Typical partial gastrectomy with button gastro-enterostomy performed. *Microscopic Examination:* Simple gastric ulcer. Uneventful recovery. Readmission June 21, 1922. Discharged June 24, 1922. *Diagnosis:* Stenosis of gastro-enterostomy stoma.

History: For the last two months patient complains of pain and frequent vomiting one hour after meals. X-ray examination of the gastro-intestinal tract shows the stoma about 1 to 1½ inches above the most dependent portion of the gastric stump. The barium passes through the stoma in a narrow stream, but

the stomach does not empty completely as late as twenty-four hours. The residue, however, seems to be in the part distal to the stoma. The stoma is normal in appearance but very tender on manipulation. Advised laparotomy but the patient went home against advice. March, 1923; Patient cannot be located.

CASE V.—O. S., forty-nine, male. Admitted to Mount Sinai Hospital, December 19, 1921. Discharged January 9, 1922. *Diagnosis*: Penetrating ulcer, lesser curvature of stomach; epigastric hernia. *Operation*: Partial gastrectomy; button gastro-enterostomy; hernioplasty.

History: Patient has been troubled with epigastric distress for the last three years; no vomiting, but considerable belching. X-ray examination shows ulcer on the lesser curvature of the stomach with one-third residue after 24 hours.

Operation: Findings: Large indurated callous ulcer of the lesser curvature densely adherent to the pancreas. A partial gastrectomy and button gastro-enterostomy were performed in the typical fashion. *Microscopic Examination*: Callous ulcer. Uneventful recovery.

Readmission June 19, 1922, for removal of button. *Operation*: Gastrotomy; removal of button. Abdominal wall closed with through-and-through silk stitches under marked tension. Healing delayed by gangrene of skin. Patient discharged with ventral hernia July 18, 1922. Reexamination: March, 1923, patient well.

CASE VI.—D. B., thirty-four, female. Admitted to Mount Sinai Hospital, June 6, 1922. Discharged June 26, 1922. *Diagnosis*: Hour-glass stomach, due to ulcer. *Operation*: Partial gastrectomy; button gastro-enterostomy.

History: Epigastric pain for six weeks. X-ray examination shows evidence suggestive of an ulcer of the lesser curvature of the stomach at or near the reentrant angle. The contour showed a marked incisura a little above the transition from the vertical to the horizontal positions. This incisura was persistent. Gastric motility was delayed.

Operation: Partial gastrectomy for hour-glass stomach, probably due to ulcer. *Findings*: A marked hour-glass stomach was found; there was a constriction at about the reentrant angle; the lumen of the stomach at this place just admitted two fingers. There were some adhesions which stretched across the stomach; these adhesions were evidently secondary to an old ulcer at this site. After the division of the stomach the hour-glass formation persisted. A partial gastrectomy with button gastro-enterostomy was performed in the typical manner. Specimen did not show any ulcer of the mucosa. The ulcer causing the hour-glass formation has healed completely. Uneventful recovery. Reexamination: February, 1923, patient well.

CASE VII.—H. M., forty-two, male. Admitted to Mount Sinai Hospital, November 24, 1922. Died December 6, 1922. *Diagnosis*: Penetrating ulcer, lesser curvature. *Operation*: Partial gastrectomy; anterior gastro-enterostomy; entero-anastomosis.

History: For past four years attacks of burning pain in epigastrium, lasting three to four weeks. Has lost about twenty pounds. Pain is accompanied by vomiting. X-ray examination showed practically complete pyloric obstruction due to adhesions at the pylorus; no evidence of penetrating ulcer at the lesser curvature.

Operation: December 4. Partial gastrectomy; anterior gastro-enterostomy; entero-anastomosis. *Findings*: A large ulcer, about one and one-half inches in diameter, was found along the lesser curvature slightly adherent to posterior parietes. The pylorus was thickened and hypertrophied. Partial gastrectomy was done in typical fashion. The closure of the upper angle of the stomach was difficult as inflammatory tissue extended a good distance beyond the ulcer. Both gastric and duodenal stumps were closed in three layers. An anterior suture gastro-enterostomy was performed, followed by a Braun entero-anastomosis. The

resection was performed with local anesthesia of the abdominal wall; a little gas was given for the closure of the abdominal wall. December 6. Patient has facies hippocratica. Pulse rapid and feeble; respirations rapid and shallow; temperature 102° ; marked general abdominal tenderness. *Diagnosis*: Peritonitis. Patient died on the same day. Post-mortem examination showed small leak at the upper angle of suture line of the stomach with secondary peritonitis. *Microscopic Examination*: Simple ulcer.

CASE VIII.—S. S., twenty-three, female. Admitted to Mount Sinai Hospital, October 27, 1922. Discharged November 21, 1922. *Diagnosis*: Pyloric stenosis due to healed ulcer. *Operation*: Resection of pylorus and antrum of stomach (Billroth I).

History: Patient has suffered severe attacks of nausea and general abdominal cramps for last year; no vomiting. X-ray examination shows a one-third residue after six hours.

Operation: Partial gastrectomy (Billroth I) for stenosis of pylorus. Median incision between the ensiform process and umbilicus. The pylorus feels markedly thickened, hardly admits tip of small finger. Resection of pylorus and antrum of stomach. Anastomosis made in Billroth I fashion using Haberer's technic as described above. Through-and-through chromic for peritoneum and fascia, silk for skin. Specimen shows markedly hypertrophic musculature at pylorus, opening just admitting lead pencil. Uneventful recovery. X-ray taken two months after operation shows perfect emptying time. March, 1923: Patient feels perfectly well.

CASE IX.—E. B., forty-five, male. Admitted to Mount Sinai Hospital, January 6, 1923. Discharged February 8, 1923. *Diagnosis*: Duodenal ulcer. *Operation*: Partial gastrectomy; posterior suture gastro-enterostomy; cauterization of ulcer.

History: Patient was admitted to the Medical Service suffering from severe pain in epigastric region. The pains were so severe that they suggested possibility of impending perforation. After the pain had subsided X-ray examination was performed, which showed an irregular duodenal hump. He was then transferred to the Surgical Service.

Operation: Partial gastrectomy; posterior suture gastro-enterostomy and cauterization of ulcer for ulcer in the second portion of the duodenum. Findings: Crater ulcer was felt in the duodenum. Duodenum made somewhat movable by splitting peritoneum on its outer border. The stomach was divided midway between the stomach and cardia. The duodenum was freed in its first portion. It was now seen that the ulcer was in the second part. Finger introduced into the foramen of Winslow, felt the common duct in close proximity to the ulcer. Division above the ulcer. Cauterization of the ulcer *in situ*. Closure of the duodenum in three layers. Posterior suture gastro-enterostomy with chromic gut. Layer suture of abdomen. Drainage with piece of rubber dam. Patient made an uneventful recovery. Re-examination March, 1923. Patient well.

CASE X.—B. S., forty, male. Admitted to Mount Sinai Hospital, February 20, 1923. Discharged March 16, 1923. *Diagnosis*: Duodenal ulcer.

History: Patient has complained of severe epigastric pain for the last two years. The attacks are so severe that the patient insists on exploratory laparotomy in spite of negative X-ray findings.

Operation: Partial gastrectomy and posterior suture gastro-enterostomy for duodenal ulcer. *Findings*: Gall-bladder showed few adhesions. A small ulcer on the anterior wall of the duodenum just beyond the pylorus, size one-half finger-nail. Duodenum bound down by adhesions. After splitting of hepato-duodenal ligament the duodenum was liberated. Gastric vessels were ligated and stomach divided about midway between the cardia and pylorus. The duodenum was dis-

sected away from the pancreas by sharp dissection and then divided just below the site of the ulcer. The duodenum was closed, using the pancreas capsule for the second and third layers. Closure of the proximal end of the stomach in three layers. Posterior retrocolic suture gastro-enterostomy. No drainage. Through-and-through chromic catgut for muscle and fascia. Interrupted silk for skin. Uneventful recovery. *Microscopic Examination*: Benign ulcer.

CASE XI.—S. P., fifty-two, male. Admitted to Beth Israel Hospital, February 13, 1923. Discharged March 22, 1923. *Diagnosis*: Pyloric ulcer with obstruction.

History: Vomiting for two months, after each meal. X-ray: Shows a large six-hour residue and a deformed cap.

Operation: February 28, 1923, four-inch pararectus incision, resection of stomach and posterior suture gastro-enterostomy for obstructing pyloric ulcer.

Findings: Pylorus very narrow and contracted. A small scar is seen next to pylorus and somewhat proximal to it on the anterior surface of the stomach. The hepato-duodenal ligament contained a number of hard glands. Stomach considerably dilated.

Operative Technic: Pylorus, antrum and first part of duodenum freed from their vessel supply sufficiently to permit a hemi-gastrectomy. Stomach then clamped off centrally and cut through. Pylorus and duodenum were densely adherent to pancreas. Capsule of pancreas cut into, to free adhesions. Distal half of stomach cut away. Duodenum closed in three layers, using the pancreas capsule for second and third layer. Proximal end of stomach closed in three layers. Posterior suture gastro-enterostomy. Uneventful recovery. *Microscopic Examination*: Healed ulcer.

CASE XII.—J. M., fifty two, male. Admitted to Beth Israel Hospital, February 26, 1923. Discharged March 24, 1923. *History*: Epigastric pain for two months. No vomiting. X-ray: Penetrating ulcer on lesser curvature of stomach.

Operation: March 3, 1923. Median incision between ensiform process and umbilicus. Penetrating ulcer three-fourths inch in diameter found at reentrant angle of stomach, not adherent to pancreas. Typical Billroth I according to Haberer's technic. Closure of abdominal wall in layers. No drainage. *Course*: Uneventful recovery. *Microscopic Examination*: Benign ulcer.

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RECURRENCE OF INGUINAL HERNIA AFTER OPERATIVE TREATMENT*

BY ALBERT S. MORROW, M.D.

OF NEW YORK, N. Y.

THE operation for the radical cure of inguinal hernia with its very low and almost negligible mortality rate, the freedom from serious post-operative complications, and short hospital confinement, has been long considered one of the simplest of major operations, and, by many surgeons, as relatively unimportant. The extremely low percentage of recurrences shown by published statistics seemed to assure the patient of a reasonable certainty of permanent cure, and, until recently, probably no operation has been generally regarded as more satisfactory in this respect.

Within the last few years the careful study given the subject of inguinal hernia has led to more accurate methods of following up cases, with a view to determining the end results, which has resulted in considerable modification of the views formerly held as to the curability of the different varieties. It is now felt that the cure of oblique hernia and direct hernia are two very different propositions. While in the former permanent relief may be obtained in a large percentage of the cases by a high ligation of the sac, supplemented by almost any of the recognized methods of repairing the canal, in the direct variety the results from operation still leave much room for improvement. When it is further considered that the great majority of inguinal herniae, probably 90 per cent. of the primary ones, are of the oblique variety, it is readily seen that statistics of recurrence in any series of cases is apt to be misleading unless the two groups are considered separately.

Reports of recurrences also lose much of their value because, on account of the difficulty in getting patients to return for examination, conclusions are often partly based upon correspondence with the patient. Such reports cannot always be accepted as reliable, since it is a well-established fact that patients frequently have slight recurrences which may readily escape attention without a careful physical examination. Some instructive figures are given in this connection by Taylor in a study of the results of operations performed for inguinal hernia at Johns Hopkins Hospital from January 1, 1899, to January 1, 1918, which appeared in 1920. He found that, while among 356 cases of indirect hernia operations examined at the hospital there were 30 recurrences, or 8.4 per cent., on the other hand, there were only 16 recurrences, or 3.4 per cent., among 460 cases of the same type of hernia who responded by letter; and, while among 47 cases of direct hernia examined there were 14 recurrences, or 29.7 per cent., among the same number heard from, only 3, or 6.3 per cent., reported recurrences.

* Read before the New York Surgical Society, April 25, 1923.

The difference of opinion as to the length of time that should elapse before a hernia can be considered cured has further confused the subject, and shows the need of a uniform standard of time for following cases if statistics of recurrence are to be of value for purposes of comparison.

Since many of our large hospitals have developed efficient follow-up systems that obviate the sources of error mentioned and require the examination of patients for at least two years after operation, the optimism that formerly prevailed as to the results from hernia operations has been somewhat dispelled, and it has become more and more apparent that the percentage of recurrences following the usual operations is very much higher than it was previously thought to be. This is especially true of the direct variety, in which the greatest number of relapses occur. The many new or modified operations that have been devised in recent years may be regarded as further evidence that surgeons are far from satisfied with their results. In some of these operations the method of dealing with the hernial sac is a feature, while in others special attention has been paid to the repair of the musculo-fascial layer of the inguinal canal by reinforcing the muscles with flaps from the external oblique aponeurosis, or by transplantation of the rectus muscle. They embody no new principles, however, all containing the main features of the original operation of Bassini, *i.e.*, the high ligation of the sac, closure of the transversalis fascia when possible, and reconstruction of the inguinal canal. It does not seem likely, therefore, that improvement in results will come from changes in the fundamental principles of the present hernia operation; rather must we look for a reduction of relapses by the elimination of errors which are shown by the conditions found at operation for recurrence to be frequent causes of failure.

For convenience, recurrences may be grouped under the following headings: 1st, those due to errors of judgment in the selection of cases for operation, or in the type of operation employed; 2nd, those due to a faulty execution of the plastic repair; and 3rd, those due to what may be termed "operative accidents."

In attempting to explain the failures to obtain cures, it must be recognized at the outset that there is a small group of cases that will probably recur, in spite of any operation that is done, the recurrence not being necessarily due to a faulty choice of operation or a poorly executed repair, but rather to the type of hernia, and to the anatomical conditions present. In general, these cases belong to a group comprising about 7 per cent. of all herniæ described nearly twenty-five years ago by Bloodgood, which are characterized by a weak or absent conjoined tendon. Herniæ associated with this defect, while more often seen in old men with relaxed abdominal walls, are also met with in young individuals who have poor or deficient muscular development in the inguinal region. If these patients while standing erect are asked to strain, there will often be revealed a bulging extending from above the anterior superior spine, parallel to Poupart's ligament, obliquely downward to the rectus muscle. On examination of the patient in the recumbent posi-

tion, a diastasis of the external oblique is at times recognized, and the examining finger will readily pass through a large external ring into the internal fossa, meeting practically no resistance until the posterior surface of the pubic bone or edge of the rectus muscle is reached. Both oblique and direct hernie are encountered in individuals of this type, the latter more frequently. According to Bloodgood, 50 per cent. of direct hernie are associated with this deficiency of the conjoined tendon, and recurrences following the ordinary operations in this variety ranged from 20 per cent. to 50 per cent.

Other questionable types of hernia, as far as cure goes, are the large oblique ones of long standing, containing bowel or omentum. In these the deep epigastric vessels have been gradually drawn downward, and the obliquity of the inguinal canal is lost, the internal and external rings being directly superimposed, so that, from an examination before operation, it is almost impossible to tell whether the hernia was originally direct or oblique. The bearers of these hernie are frequently men past middle age, who have worn trusses so long that the tissues immediately surrounding the ring are weakened and stretched from pressure to such an extent as to be almost useless for the repair of the canal. So-called "sliding hernie" are sometimes encountered in these patients, and then, in addition to the difficulty of repairing the canal, is added the problem of managing the protruding intestine. Under the most favorable conditions of closure there will remain a small portion of bowel uncovered by peritoneum, which presents at the internal ring, ready to escape and spread apart the repaired canal.

Many cases belonging to the groups mentioned above should never be submitted to operation, and, unless a certain degree of selection be exercised, recurrences will remain on the high side. A careful examination and sound surgical judgment, based on a wide experience, are required in order to choose from this group those patients upon whom operation may be undertaken with a reasonable assurance of success.

The failure to recognize that no one operation is suitable for all types of hernie is undoubtedly responsible for many relapses. In oblique hernia removal of the sac to such an extent that there is no dimpling of the peritoneum, forms an important feature of practically all the recognized operations. This simple procedure alone, if properly done, is sufficient to produce a cure in certain of the hernie of this type, where the muscles are well developed, and there is not an undue widening of the inguinal canal. There is still considerable difference of opinion as to the desirability of transplanting the cord in these oblique hernie. Theoretically, leaving the cord untouched in its natural bed, as is done in the Coley-Bull, the Ferguson, and other operations of the same type, should give better results in this variety than transplantation, because the weak point, the opening for the cord, is transferred to a distance from the internal ring, which in turn is strengthened by a buttress of muscles. In the experience of the writer, however, this theoretical advantage has not been proved in practice, and there has been a slightly larger

percentage of recurrence from this so-called anatomical operation in my hands than where the cord has been transplanted, the recurrences in most instances taking place at the lower angle of the canal, at the point of exit of the cord. As a result I have returned to the transplantation of the cord, employing the Bassini or the Andrews operation, except in the case of children or in the presence of an associated undescended testicle.

In the direct variety of hernia it is generally agreed that the best results follow transplantation of the cord. In this type, when the muscles are strong and bulky, and the sac is small, the Bassini operation will give good results. These conditions, however, are rather exceptional in direct hernia, and it is usually necessary to secure additional strength by suturing the inner leaf of the aponeurosis of the external oblique to Poupart's ligament, as is done in the Andrews and other similar operations. Even this procedure may be insufficient in some cases of direct hernia as well as indirect, of the types already discussed, where at operation a large sac and a wide inguinal canal is found, with practically nothing but a weakened layer of muscle and fascia to utilize in repair. These questionable cases, if operated upon at all, will frequently require further reinforcement for the posterior wall of the canal, which may be obtained by transplantation of the rectus muscle.

The importance of thoroughly separating the neck of the sac from the surrounding transversalis fascia, and performing a high ligation, has already been referred to. The neglect to properly carry out this detail of the operation is no doubt responsible for many of the relapses in oblique cases, the recurrence occurring at the internal ring, and, as a rule, following the course of the cord. Recurrence at this point may also follow an operation where too large an opening has been provided for the transplanted cord. This is not so liable to occur if care is taken to remove from the cord the excess of fat, and any lipomata, and to excise varicosities, so that the space necessary for its exit from between the muscles and ligament will be reduced to a minimum. As a further precaution it is advisable to draw the muscles snugly about the cord by one or more sutures placed lateral to the internal ring, as suggested by Coley. In small hernie of the direct variety some operators do not seem to attach a great deal of importance to removal of the sac, and it is sometimes untouched, on the ground that it is so small there is really nothing to resect. Removal of these small sacs, or what often only amounts to taking up the slack in a slight bulging of the peritoneum, followed by closure of the transversalis fascia, is felt to be just as essential a step as it is in the larger and more completely developed protrusions, otherwise a potential wedge is left that tends to enlarge and separate the repaired structures, no matter how well the reconstruction may have been performed.

Another technical error that has seemed to me a most frequent cause of recurrence is the failure to recognize the presence of a hernia of the "saddle-bag" or "pantaloons" type, where the sac bulges on both sides of the deep epigastric vessels and to remove both portions of it. This type of hernia, which is probably rightly considered primarily direct, though, strange to say,

not mentioned in most works on surgery, is fairly common. Recently in an examination of the operative findings in 40 cases of direct hernia a well-marked double sac was found in 25 per cent. of them. Others have placed the incidence of this condition very much higher. Hognet stating that it is possible to demonstrate a small indirect sac in all direct hernie. The double sac is probably less frequently overlooked where the direct part of it is the more prominent lesion, but may readily escape attention where there is a fairly large oblique sac, and only a small bulging in Hesselbach's triangle. Under these conditions the small direct sac may be missed, unless one makes a habit of palpating at operation the internal fossa through the opening of the oblique sac, or, when operating under local anesthesia, having the patient demonstrate by coughing the presence or absence of a combined sac. The fact that many of the oblique hernie do not recur through the internal ring, but in the form of direct, always suggests the possibility that a direct sac was overlooked at the original operation, or was in an incipient stage of development at that time. In these cases evidence of recurrence is present as a rule fairly early—usually within a few months. These direct-indirect hernie should be treated by the same methods of repair as the direct. The double sac may be converted into one by pulling the direct portion upward and out, and pushing the deep epigastric vessels down, as suggested by Downes, Hognet and others; or these vessels may be first ligated and cut. I am not aware that one method has any advantage over the other, as far as ultimate results go. When operating under local anesthesia, however, my impression is that ligation of these vessels is preferable, causing less discomfort to the patient than the pulling upon the peritoneum incident to converting the direct sac into an indirect one.

One of the essentials of any plastic operation, *i.e.*, that the parts entering into the repair of a defect be united without tension, is especially desirable in hernial repair, where the structures one attempts to unite are, at best, poorly adapted for such union. To meet these requirements it is important that the sutures be tied evenly, and with only enough tension to just approximate the structures entering into the repair, otherwise strangulation will occur, and the normal muscular and fascial tissues will undergo fibrosis. That the structures utilized in the repair of the inguinal canal are often too forcibly drawn together and held with heavy sutures under tension is evident from the condition sometimes found at operation in recurrent cases. The line of suturing will be found intact, but the edge of Poupart's ligament will be torn away with a recurrence through the rent, or the internal oblique and conjoined tendon will appear as a thin and weak layer of fibrous tissue through which the recurrence has taken place mesially. In cases where it is evident that approximation cannot be obtained without tension, I have found Lyle's suggestion for obtaining relaxation of the inguinal triangle by flexion and inward rotation of the thigh, combined with slight elevation of the trunk, to be of great assistance, not only for the immediate requirements of the operation, but as a routine part of the post-operative treatment.

Recurrence, associated with marked atrophy and thinning of the muscles, will also occur as the result of destruction of the nerve supply of the muscles by cutting or inclusion in the sutures at the original operation. The late Doctor Bodine, in one of his early papers on local anesthesia hernia, was among the first to emphasize the desirability of preserving the nerve supply of the inguinal region for the purpose of avoiding subsequent atrophy of the muscles utilized in the repair. Dowd and a few others have also called attention to this subject, but the importance of this small detail does not seem to be generally recognized or admitted.

Among the complications and accidents of operation, suppuration stands foremost as a causative factor of recurrence, and in operations where this complication occurs relapses may be expected in about one-third of the cases. Taylor, in his review of Johns Hopkins' cases, reports 8 infections among 816 hernia of the oblique variety, with 2 recurrences, or 25 per cent., and among 94 direct cases, infection occurred 4 times—2, or 50 per cent., of which recurred. The recurrences following infection usually show a diffuse scar formation, and the muscles and tendinous structures of the canal are widely separated, the protrusion taking place at any point in the canal. Slight forms of infection also predispose to recurrence when they involve the deeper structures. These low-grade infections are sometimes only evidenced by a small collection of serum which slowly works to the surface under the scar, and in the discharge that escapes remnants of the deep sutures occasionally may be recognized. Though often apparently insignificant, infections such as these may result in premature separation of the deep stitches, with a consequent weakening of the reconstructed wall. To lessen the chances of sepsis, and provide the most favorable conditions for primary union, avoidance of rough handling of the tissues while operating, and securing of complete hemostasis, are essential. Both traumatism and the subsequent oozing may be reduced to a minimum by substituting clean cut dissection for the old methods of defining the hernial sac by blunt dissection, or by separating the tissues with a swab.

There are recurrences occasionally encountered where at the second operation there is no evidence of any union between Poupart's ligament and the muscles of the abdominal wall, the parts either appearing as if no operation had been done, or there being the remnants of only a few bands of tissue extending between the previously united structures. This is usually explained as being the result of premature separation of the deep sutures, due to their being improperly tied, or too rapidly absorbed. Another possible explanation of such a condition, which has not received much attention, can be found in the retching and vomiting that occurs after general anaesthesia. The pressure exerted upon the lower part of the abdomen and the abdominal muscles by the patient recovering from the influence of a general anaesthetic is considerable, and places a severe strain on the recently repaired hernia, which may be sufficient to cause the sutures to cut through, if the tissues are

under tension to begin with. For this reason the avoidance of general anesthesia in hernia operations has seemed to me highly desirable, and for the past fifteen years local anesthesia has been used as a routine in these operations, with the feeling that, in addition to its other advantages, one possible cause of recurrence was eliminated.

Another somewhat similar accident to which some relapses have been attributed is the slipping of the ligature from the neck of the sac. Moschcowitz mentions two cases where he felt that this had taken place, because at re-operation the hernial contents were not covered by any parietal peritoneum, being simply buried in a mass of loose adhesions. In none of the recurrences that have come under the writer's observation could this be shown to be the cause of relapse, but the accident has occurred within my knowledge after ligation and removal of a fairly large oblique sac, the operator being compelled to re-open the wound within a few hours on account of hemorrhage. An instance is cited by Seward Erdman where, in a bilateral operation done at one sitting the ligature slipped off the first side, the accident being recognized by the presence of blood in the peritoneal cavity when the second sac was opened. Erdman also calls attention to an observation that in operating for bilateral hernia, especially direct, it is possible in ligating the sac on one side to exert sufficient traction to be felt on the opposite side; in view of which, this accident must be looked upon as a possible though rather infrequent cause of some of the recurrences.

In individual cases probably other explanations of the failure to obtain a cure may be found, as operating in the presence of definite contra-indications, such as chronic cough or chronic urinary obstruction; permitting the patient to undertake heavy work too soon; and the wearing of a truss after operation.

SUMMARY

It is felt that the operative cure of inguinal hernia is not the simple procedure that many surgeons regard it, but is an operation requiring sound surgical judgment, as well as considerable technical skill.

Oblique and direct hernia should be looked upon as two distinct conditions, in both of which recurrence is probably more frequent than was formerly recognized—this being especially true of the direct form.

Improvement in operative results is not likely to come from the development of an operation based upon new principles, but in the elimination of what are considered to be frequent causes of failure to obtain a permanent cure. These are:

(1) Subjecting to operation patients in whom, on account of the type of hernia, and the condition of the parts that must be utilized for repair, there is small chance of obtaining a permanent cure.

(2) The use of an operation which, while adequate in some cases, fails to meet the indications in an individual case.

POST-OPERATIVE RECURRENCE OF INGUINAL HERNIA

- (3) The failure to thoroughly remove the sac or to recognize and remove a double sac.
- (4) Repair of the canal under tension.
- (5) Injury to the nerve supply of the inguinal region.
- (6) Infection.
- (7) Separation of the repaired structures from a failure of the sutures to hold, or from the strain of post-operative vomiting.

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TREATMENT OF WEBBED FINGERS CONGENITAL OR ACQUIRED*

BY G. M. DORRANCE, M.D.

AND

J. W. BRANSFIELD, M.D.

OF PHILADELPHIA, PA.

THE term webbed fingers is used in describing all cases where the fingers are all joined together. As a matter of fact, a distinct web such as found in a duck's foot seldom exists. As a rule, congenital webbed fingers are associated with deformity of the phalanges. The web varies in size and extent in different cases, and not infrequently in the same hand or foot, it may be only a suggestion of one or extend to the extreme tip of the finger or toe.

A number of operations to correct the deformity have been proposed. The operations in general use are those advocated by Didot and Agnew. In our experience, neither of these types nor their modifications are successful in cases where the web is narrow or in the acquired type, due to burns. The object of any operation is to cover the entire denuded area and to prevent recurrence of the web. The former is accomplished by use of the Ollier-Thiersch graft and the latter by the Agnew flap, if it is made especially long. The sloping found in a normal hand starting from a point midway between the heads of the metacarpal bones to a point opposite the middle of the first phalangeal bone is accomplished nicely by the Agnew flap. An Agnew flap is outlined and dissected free to its base.

The web is then divided in the mid-line well beyond where the normal web would be, then by pressure with your gloved finger the separation of the soft tissues should be continued until you have the separation deeper than in the normal hand. We advise this division to be made by blunt dissection so that the nerves and blood vessels to the fingers will not be divided. The Agnew flap is now sutured in place. (See Figs. 1 and 2.)

An impression of the area between the two fingers produced by the division of the web as shown in diagram number three is then made in modelling compound and after covering the raw surfaces with an Ollier-Thiersch graft, the modelling compound is reintroduced over the graft. This modelling compound has the advantage of keeping the fingers well separated and holds the grafts in accurate approximation with the raw surface, thus preventing serum from collecting under the grafts, as well as keeping the grafts at body temperature.

Our attention was directed to this method by the uniformly good results we obtained by skin grafting within the month by the use of modelling compound dressings. We have found it advisable not to do more than one web

* Read before the Philadelphia Academy of Surgery, April 2, 1923.



FIG. 1.—Agnew method.



FIG. 2.—Agnew flap in place.



FIG. 3.—Modelling compound impression being made.

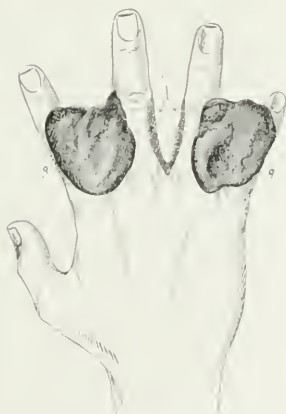


FIG. 4.—Compound removed, showing denuded area to be covered with graft.

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on adjoining fingers at one sitting. The whole hand, including the modelling compound, is placed on a splint extending well up the forearm to prevent any extension or flexion of the fingers. We do not dress the case for four days. At the end of this time, we remove the splint and dressings, and with the modelling compound still in place, irrigate the fingers with boric acid and cleanse the skin with green soap. The modelling compound dressing is removed in approximately ten days.

In the acquired type of webbed fingers due to burns, etc., an Agnew flap is often impossible to obtain. In these cases, we make a central division of the web, then take an impression in modelling compound; with the fingers well separated from one another, as shown in figure number three. An Ollier-Thiersch graft is placed over the entire area and the compound is reintroduced over the graft as in the operation for congenital webbed fingers. See figure number four. Here again our successful takes have been very gratifying. In burned hands, wherever possible, we attempt the skin grafting before contraction takes place, assuming the bacteria to be less than five to the field and no hemolytic streptococci present.

In both the congenital and acquired types, massage and stretching, both active and passive are necessary to prevent subsequent limitation of motion.

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held April 2, 1923

The President, DR. JOHN H. JOPSON, in the Chair

LANE PLATE HEALED IN PLACE

DR. ADDINELL HEWSON presented a bone attached to which was a Lane plate, healed in. The specimen was found on the dissecting table.

SPINA BIFIDA OCCULTA

DR. JOHN SPEESE reported the case of a man, age twenty-eight years, who was admitted to the Presbyterian Hospital, January, 1920, with the following history: Eight years ago while exercising he fell and struck his back. He felt a severe pain and a distinct snapping, which was accompanied by a sensation of lack of support in the lumbar region. The pain was so severe and so continuous that he was confined to bed for several weeks; the distress was relieved by strapping, although a certain amount of pain persisted. X-ray examination showed a defect in the posterior arch of the fifth lumbar vertebra, due to non-fusion of the laminae and spinous processes. The condition was diagnosed as spina bifida occulta and an operation was advised. This was refused, and for the relief of the pain, a brace was made which supported the spine from the shoulders to the hips. A considerable amount of relief was experienced after the application of the brace, but the pain was more or less constant, although not severe in character. For the past eight years he has carried on his profession as a dentist, although the constant standing has caused more or less persistent backache. Any undue exertion increased the amount of discomfort.

On examination a distinct defect (Fig. 1) was felt in the fifth lumbar vertebra, and over this region there was a crescentic growth of hair.

In January, 1920, an operation was performed by Dr. J. E. Sweet and the reporter. An incision over the vertebrae revealed the defect in the fifth lumbar; the ends of the processes were slightly movable and undoubtedly allowed a certain amount of play, which it was thought would account for the pain complained of by the patient. The ends of the defect were freshened, and brought together by kangaroo tendon, the erector spinae muscle, which had been detached, was then sutured closely to and over the defect, in order to give all possible support to the area. Immediately following the operation, the patient experienced great relief

from his pain. He was able to lie on his back with comfort for the first time in many years. Previously, it was necessary for him to sleep on the abdomen, and he was unable to turn in bed on account of the pain which such motion caused. The wound healed by first intention, and in two weeks the patient was up and about. The use of the brace was advised for several months, in order to promote firm union.

Subsequent history: At the end of two months the brace was discarded and the patient was able to resume his profession with very little discomfort. An occasional attack of backache was experienced, however, if he were indiscreet in exercise or exertion; these attacks gradually diminished until after the lapse of a year, he was able to exercise without experiencing any trouble.

DOCTOR SPEESE said that spina bifida occulta may be defined as a congenital cleft or defect in one or more of the spinous processes or laminae of the vertebrae without an external sac being present. The subject was reviewed in 1921 by Christopher (S. G. O., 1921, 33, 1) from whose article the following facts are abstracted: The incidence of spina bifida occulta has been placed



FIG. 1.—Spina bifida occulta.

as high as 5 per cent., but X-ray studies of 1000 consecutive cases disclosed incomplete closure of the vertebral posterior arches in the last lumbar vertebra to be present in 2.3 per cent.

Brickner concludes from his studies that there may be a cleft of varying length or breadth in one or more of the arches accompanied by one of the following conditions:

- (1) A distinct meningocele protruding through the cleft.
- (2) Closure of the cleft by a tough membrane adherent to the overlying skin or non-encapsulated fat and connective tissue.
- (3) Perforation of the membrane by a dense band attached to the subcutaneous tissues externally and compressing the cord structures internally.

- (4) Lipomatous tissue within the canal concealed by this membrane.
- (5) Bulging of the dura mater.
- (6) An exostosis within the canal compromising the cord tissues.
- (7) A myofibrolipoma extending through the cleft and into the bony canal, disturbing and compressing the cord and its roots.
- (8) Degeneration of the cord tracts.

Hypertrichiasis over the area of the spine affected is present in the majority of cases, but the defect is not always present in cases of hypertrichiasis. Vesical incontinence has been present in a large per cent. of cases, and enuresis in children is common. Foot deformities are variable, and corns and calluses are frequent.

Pain has been inconstant; it may be present in the region of the defect or even referred to the legs.

A very constant physical sign is the presence of one or two sacral dimples. Congenital lipomata are not uncommon, and scoliosis is frequently encountered.

The treatment is of two general types, symptomatic or palliative, and radical. The symptomatic treatment has been of little use and the palliative results, in many cases, have been unfavorable, owing to the fact that the degenerative and neoplastic processes are unremediable by surgical methods. Brickner believes that the cases in which there is a hernia of the spinal roots probably offer the best chance for a good result. His indications for operation are (1) in infants and children with spina bifida occulta without symptoms, in the hope of obviating symptoms, and (2) in adults with symptoms.

Christopher reports a case which is of interest, in that it seems to show that spina bifida occulta is a potential weakness of the body structure, and that an injury by violence to the sacrum or lower lumbar vertebræ may produce, temporarily at least, such symptoms as are found in some of the well-marked cases of spina bifida occulta with symptoms.

The case now reported resembles Christopher's in that violence caused symptoms to develop in the spine, potentially weakened by a defect previously unrecognized and not causing any disability. In this case, however, there was no loss of control of bladder or rectum. The case is of interest also because a comparatively simple operation relieved the backache apparently by fixing the ends of the processes and thus preventing motion.

SUBASTRAGALOID DISLOCATION

DR. JOHN SPEESE showed an X-ray (Fig. 2) and reported the following case of subastragaloid dislocation which he thought of interest in that the dislocation was unaccompanied by any evidence of fracture. The patient, a woman forty-five years of age, was admitted to the Presbyterian Hospital for an injury sustained in falling down a flight

of steps. The right ankle was much swollen and cedematous on the inner side, the skin was tense and stretched over the external malleolus, the foot being inverted. The astragalus could be felt on the outer side of the dorsum of the foot, and there was great pain on any sort of motion.

Under nitrous oxide anesthesia the dislocation was reduced with very slight effort. The foot was placed in a fracture box until the marked edema subsided, and a plaster case later was applied. An X-ray examination at this time showed complete reduction, and nine months after the accident the patient reports that she is able to walk without inconvenience or any degree of disability.

THORACOPUNCTURE FOR REMOVAL FROM LUNG OF PENETRATING FOREIGN BODY

DR. CHEVALIER JACKSON presented a man from whose lung he had removed by thoracopuncture a penetrating foreign body. In connection with the presentation he emphasized the fact that without Doctor Manges and his double plane fluoroscope the procedure would have been very dangerous, if not impossible. With guidance in two dimensions absolute precision obviates unnecessary trauma. He did not regard thoracopuncture as the proper procedure for every aspirated foreign body. Any good bronchoscopist can remove such bodies through the mouth with a bronchoscope; but an unskilled bronchoscopist may need a thoracic surgeon to repair the mediastinum—if the patient survives.

DOCTOR SHALLOW said that the whole question of removing foreign bodies from the lungs had been greatly altered by the War. Previous to that time very little was done in a systematic way. During the period of the War, Duval attacked the problem of the removal of foreign bodies from the lungs by resecting a piece of rib, herniating the lung, isolating the foreign body with the fingers, cutting into the lung and removing the foreign body, controlling the hemorrhage with sutures. Marion suggested suturing the parietal and the visceral pleura if they are not adherent. He penetrated



FIG. 2.—Sole astragaloid dislocation.

the lung with the finger, isolated the foreign body and passed a clamp along his finger, using the finger as a guide to direct him to the foreign body, and removed it. The bleeding was controlled by a tampon. Mauclair advised the removal of foreign bodies through a small opening. In some cases he resected the rib. He introduced a slender instrument through the chest wall and lung, and, with the aid of a fluoroscope, he removed the foreign body. Marion's technic was modified by Pettit de la Villeon. Under local anaesthesia he penetrated the chest wall and the lung and with the aid of a fluoroscope removed the foreign body. This method is similar to that used by Doctor Jackson in his case.

A case under his own care was associated with a streptococcic empyema. There was a staple in the posterior mediastinum, having been pushed there through the bronchus during an attempt at removal with the bronchoscope. Four ribs over the abscess cavity were resected. After the pus was evacuated it was found that the heart and lung were so adherent to one another that it was impossible to free the lung from adhesions. Under the fluoroscope the foreign body was removed by passing haemostatic forceps through the lung, after first cutting the thick visceral pleura with scissors. There was not sufficient bleeding in this case to require suture or tampon. The case made a complete recovery.

REPAIR OF LOSS OF BRIDGE OF NOSE AND COLUMELLA DUE TO CONGENITAL SYPHILIS

DR. ROBERT H. IVY reported the case of a boy fourteen years of age who was referred to him by Dr. Benjamin Singer. At various times since birth he had had outbreaks of typical syphilitic lesions. Eight years ago ulceration in the nose resulted in loss of cartilage and bone. He had also been treated for interstitial keratitis. He had active anti-syphilitic treatment until a short time before first seen by the reporter. At this time no active lesions were present and the Wassermann reaction was negative. Examination of the nose showed typical depression of the bridge due to loss of septal cartilage, the skin over the bridge being intact and freely movable. The entire cartilaginous septum, inferior turbinated bones, and columella were gone.

July 7, 1922, under ether at the Polyclinic Hospital, two vertical parallel incisions, 1 cm. apart, were made through the full thickness of the middle of the upper lip, including the mucous membrane. The mucous membrane was removed from the lower end of this flap, and the raw surface sutured to a previously freshened area just beneath the tip of the nose, the columella being thus reconstructed. The divided halves of the lip were then brought together and sutured. Restoration of the columella by this means was first described by Blandin in 1836. No visible deformity of the lip results.

August 25, 1922, the bridge of the nose was restored by a piece of the eighth right costal cartilage inserted beneath the skin through an incision made in the glabellar region.

ANKYLOSIS OF MANDIBULAR JOINT

Healing occurred normally, and the treatment resulted in marked improvement in the appearance of the patient.

DR. JOHN B. ROBERTS mentioned a case in which he used a peg of cartilage, shaped like a nail, to keep the whole of the nose elevated when the columella lacked rigidity.

The point of the seventh or eighth rib cartilage was used and thrust through a slit made in the columella so that the point of the cartilage rested on the upper jaw at the nasal spine.

ANKYLOSIS OF MANDIBULAR JOINT—ARTHROPLASTY

DOCTOR IVY reported the case of a man, aged twenty-two years, who until 1920 never had any trouble with his jaw. In 1920, he had double pneumonia followed by empyema. Complicating this was necrosis of the sternum at the level of the third rib. He had rib resection and drainage on both sides. During this illness there was also a metastatic arthritis of the right mandibular joint, which did not go on to suppuration, but which left him with limited motion of the jaw.

In June, 1921, still unable to open the jaws more than 1 cm., an impacted lower right third molar tooth, regarded as a possible contributing factor in the ankylosis, was removed, and while the patient was under the anæsthetic, the jaws were forcibly opened to a width of about 2 cm. between the upper and lower incisors. Following this, and division of peri-articular adhesions in February, 1922, the former condition of almost complete ankylosis returned.

In October, 1922, it was found that the upper and lower incisors could not be separated more than 1 cm., and that attempts to force the jaws farther apart produced pain in the right mandibular joint. In opening, the mandible seemed to move toward the right side, with the fixed right condyle as a pivot. No outward facial deformity, such as is seen in cases of ankylosis occurring before full growth of the mandible, was visible.

October 13, 1922, at the Polyclinic Hospital, under ether, an incision was made through the skin, beginning below just in front of the lobe of the right ear, passing vertically upward to a point opposite the upper attachment of the pinna, then extending upward and forward in a curved manner to the level of the top of the pinna, then downward and forward to end at a point about 3 cm. in front of the upper attachment of the pinna. The skin flap thus outlined was then turned down. A flap of superficial fascia with the same outlines as the skin flap was now made, the posterior attachment of the masseter severed from the zygoma, and the neck of the condyle exposed. With a narrow gouge, the neck of the condyle was divided, about 0.5 cm. of bone being removed. This permitted free opening of the jaws to the full extent. The end of the flap of superficial fascia was fixed with catgut sutures between the bone surfaces, to prevent them from reuniting, and the skin flap was sutured back in its original position, a temporary rubber dam drain being inserted at the lower angle to prevent accumulation of blood. A wooden wedge was wired between the teeth of the right side to keep

the mouth open, but this gave so much discomfort that it was removed the next day without untoward results.

The patient made an uninterrupted recovery and was discharged from the hospital on October 18.

Since that time he has had full use of the jaw, with maintenance of ability to separate the upper and lower teeth to a normal extent.

Operations for the relief of bony ankylosis of the mandible are not new. In 1855, Esmarch recommended removal of a wedge-shaped piece of bone from the angle, and Wilms of Berlin first successfully performed the operation in 1858.

The first removal of the condyle was performed by Humphry, in 1856. In 1883 Heath resected the neck of the condyle through an incision in front of the ear. Similar operations are described by Gross (1874), Mears (1883), and other American surgeons.

Coming to more recent times, Blair, in *Surgery, Gynecology and Obstetrics*, 1914, vol. xix, p. 436, gives a very exhaustive analysis of 212 cases including several of his own. In 1910, before the St. Louis Medical Society, Blair first presented the operation used in the case reported here. The incision gives free access to the joint and at the same time avoids important seventh nerve branches. With the angular incision described later by Murphy (*Jour. A. M. A.*, 1914, vol. lxii, p. 1783) there would seem to be more danger of paralysis of the orbicularis palpebrarum and certainly of the occipito-frontalis.

DR. GEORGE M. DORRANCE said that he had seen that day two cases in which he had performed arthroplasty within six months. Not only was bony ankylosis present in these cases but the muscles were short and fibrous, much more so than in the normal muscles. In looking over a number of cases he had been impressed with the fact that they recur. Something over a year ago he started in with mechanical exercises of various types. In the two cases now referred to the exercises had been of great value. The ankylosis had existed in these cases from twelve to fourteen years before operation. They had started to ankylose between eight and ten years of age so that the bone was not developed as the adult bone would have been.

The most important thing is that these exercises have kept the distance as long as they were used. When they were stopped, contraction again set in. In all these cases of long duration one should not expect these muscles to get back their function again any more than one would expect an arm to do so after it has been in a sling a long time.

DR. A. BRUCE GILL said that he had operated upon two cases of ankylosis of the jaw. In June, 1919, a boy of seventeen years from Birmingham, Alabama, was brought to Philadelphia by his father because of ankylosis of the jaw which had existed since early childhood. The father had been away from home during the boy's infancy and could give no history of the cause or development of the ankylosis. There was a history, however, of an osteomyelitis of the femur with sinuses which discharged for several years.

The boy presented a very marked retrognathism, or under-development of the lower jaw. His lower teeth in front were fully one-half inch behind the upper teeth, and by means of this orifice the boy was able to introduce meat and other articles of a general diet into his mouth, where he partially masticated them with his tongue before swallowing. There was no perceptible motion of the lower jaw either side-wise or up and down. They were unable to tell by examination, or by means of any inequalities of the two sides of the face, or by X-ray examination which temporo-mandibular joint was ankylosed, or whether both were involved. A small linear scar about one-fourth inch in length in the region of the left joint suggested that an incision had been made at some time, possibly for metastatic abscess following the osteomyelitis of the femur.

Doctor Ashhurst examined the case with him and assisted in the operation. An incision was made along the lower border of the zygoma, going directly down to the periosteum. The incision was carried downward for about an inch in front of the ear. The soft tissues were retracted downward, exposing the region of the joint. No line of demarcation of the joint was evident. There was bony union of the entire width of the mandible, including condyle, coronoid, and sigmoid fossa, with the glenoid fossa and the zygoma. The ramus of the jaw was divided with biting-forceps and osteotome across its entire width below the zygoma without injury to neighboring vessels or nerves. The jaw could then be opened about an inch. When the jaw was closed there was a gap of about one-quarter of an inch between zygoma and mandible. The wound was closed and healed promptly.

A hard rubber screw was used during the after-treatment to force the mouth open more and to maintain the opening, but its use was more or less painful and caused loosening of the teeth. Many of the back teeth were unerupted.

The boy left for home at the end of a month able to open his mouth about one inch and to close it again. There was no soreness in the muscles of mastication nor about the joints.

He returned to Philadelphia at the end of five months because of a relapse and inability to open the mouth.

A second operation, similar to the first, was done. Bony ankylosis was present. Three-eighths of an inch of bone was excised. The mouth could then be opened an inch, when it was observed that the bony gap increased to beyond a half-inch. A free transplant of fat from the thigh was then placed between the bones and wound was closed.

Following this operation several rubber wedges of different sizes were employed to keep the mouth open. It was found, however, that there was no tendency to relapse, as after the first operation, but that there was constant improvement in the use of the jaw and without pain. Voluntary motion increased from three-fourths to five-fourths of an inch during the following month. The patient reported some time after his return home that he had good motion in his jaw and that he was entirely satisfied.

The second case was that of a colored girl of fourteen years with

complete ankylosis dating from infancy, cause unknown, marked retrognathism, and again no sure indication by inequality of the face or by X-ray examination as to which joint was ankylosed. Operation was performed on the right side, when a bony ankylosis between mandible and zygoma was found extending from the condyle almost to the tip of the coronoid process, with obliteration of the sigmoid notch. With osteotome and mallet a gutter was cut across the mandible just below the zygoma, and the opening was enlarged with rongeur forceps to a width of five-eighths of an inch. The jaw could then be opened almost an inch. A free fat transplant from the thigh was placed between the bones, and the wound was closed.

A dental instrument consisting of hinged plates for the upper and lower teeth with a screw was obtained and used in the after-treatment.

This patient gained steadily in the use of her jaw and obtained a splendid result.

From these cases he learned that it is better to interpose soft tissue between the raw bony surfaces to prevent relapse, and that one is not always able to tell by any means of examination on which side the ankylosis is present. The operation by means of the method described is easy and is free of danger of injury to vessels and nerves if one uses precaution and gentleness.

Dr. J. T. RUGH said that last year he had the pleasure of seeing one of the cases which Doctor Mears did many years ago. The patient is now a physician in Western Pennsylvania. He still has excellent function in the jaws as the result of that operation. It seemed to him that one of the greatest things that Murphy has shown has been the uncertainty of arthroplasty. Subsequent studies of his cases show recurrence of the ankylosis, not only in the jaw but in other parts of the body. The results of arthroplasty can not be estimated until three or four years have passed. This result of Doctor Ivy's is beautiful, but it is only at the end of seven or eight months. The speaker wanted to know what the result is at the end of three or four years. All surgeons know what it is to have recurrences when dealing with bony ankylosis.

Dr. JOHN H. JORSON said that these are not very common cases. Dr. J. Ewing Mears, a former President of the Academy, was a pioneer in this field, and showed several cases at a meeting many years ago. Mears' work ought to be kept in mind and the part that he played in helping what seemed almost an incurable deformity at that time. John B. Murphy's report before the American Surgical Association in 1914 also should be recalled. The speaker had operated on and exhibited one case here, a case of double ankylosis, treated by the Lilienthal method, including osteoplastic resection of the zygoma. The cosmetic result was inferior to that obtained by Doctor Ivy, which is the best he had seen; but the functional result was excellent. If the ankylosed joint is thoroughly resected and this followed by an arthroplasty along modern lines, one should not expect a recurrence.

DOCTOR IVY, in closing discussion, said that the determination of which side

is ankylosed generally presents little difficulty. In cases of long standing a careful study of the deformity due to lack of use will frequently determine this point. The ramus of the mandible on the ankylosed side is usually shorter vertically, giving that side of the face a full, rounded appearance, whereas the opposite side is flattened. Mistakes, however, have frequently been made, the flattened or sound side being opened first because it looks more abnormal than the other. The X-ray generally gives very little aid on this point.

If the jaws do not open by free removal of bone on both sides, the remaining ankylosis is due to contracture of the soft tissues and these must then be divided or removed as far as is necessary. One case seen in the army was due to myositis ossificans of the masseter muscle, requiring complete excision of the muscle.

It was undeniable that final conclusions as to the result of operation in these cases could not be reached until at least two years have elapsed. They practically all require the use of muscle exercisers to maintain mobility.

TREATMENT OF WEBBED FINGERS

DRS. G. M. DORRANCE and J. W. BRANSFIELD read a paper with the above title, for which see page 532.

DR. A. BRUCE GILL said that he had operated on a few cases of congenital syndactylism, and obtained fair results by a plastic operation. The skin on the dorsum of the hand is very loose, and a triangular flap with the apex at the web of the fingers can be drawn downward to cover not only the raw surface between the fingers, but also part of the side of a finger.

One should not operate on infants or young children probably before the age of ten or twelve years, because the scar on the lateral surface of the fingers contracts and causes a lateral bowing of the fingers. The fingers are so small and the scar so relatively large that deforming contracture can not be prevented.

DOCTOR DORRANCE said he had had no experience at all with children. The simplicity and success of this method came to his notice in the army, after explosions where the whole hand would be burned. They put these grafts on and thought they had remarkably good results. It is a local anesthesia job, simple and easy. The only trouble with flaps from the abdomen is that they are liable to take on fat and for this reason they had not been entirely satisfactory to him. They had been making their grafts a little thicker recently, they are half-way between a Wolf and an Ollier-Thiersch method. In burn cases this method has been particularly satisfactory.

DR. JOHN H. JORSON said that he had found the Agnew or Zeller operation a good one, but in operating in young children it has the fault that it does not provide for early healing of the lateral incisions on the fingers beyond the web. Scars at these sites do not grow proportionately to the growth of the hand, and the resulting contraction draws down the interdigital fold of skin and results in partial relapse. The method recommended by Doctor Dorrance obviates to some extent this difficulty.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held April 11, 1923

The President, DR. JOHN A. HARTWELL, in the Chair

DISLOCATION OF SCAPHOID OF TARSUS—OPEN REDUCTION

DR. JOHN A. McCREERY presented a man, aged thirty-three, who was admitted to the First Surgical Division, Bellevue Hospital, March 8, 1921. Shortly before admission he had fallen 18 feet, landing on the ball of the left foot. The fall was followed by intense pain and inability to walk. When seen shortly after admission the left foot was swollen. There was distinct dorsal prominence in the region of the scaphoid. There was .5 cm. shortening in the measurement from the head of the first metatarsal to the tip of the internal malleolus as compared with the opposite side. X-ray showed dislocation of the scaphoid dorsally with a fracture of the tuberosity, the latter fragment displaced somewhat backward.

Two attempts at closed reduction were made without success, and an open reduction was performed four days after injury. The scaphoid had been broken into two pieces by a vertical line of fracture which separated the tuberosity from the body. The latter was dislocated on to the dorsum of the foot, the displacement being in part a direct displacement upward, but chiefly a rotation on the transverse axis of the bone, so that the articular facets for the cuneiform bones were directed upward and forward at an angle of about 60 degrees from the normal position. The dorsal ligament uniting the scaphoid to the cuneiform bones had been torn from the latter. The plantar ligaments were apparently intact. The inability to effect a closed reduction was apparently due to the impossibility of drawing the cuneiform bones away from the articular surface of the astragalus to which they were approximated and also to inability to rotate the scaphoid by external pressure. Reduction was easy after the internal cuneiform had been displaced distally with a periosteal elevator, thus opening the space between the astragalus and cuneiform bones, and allowing the scaphoid to be rotated into place by direct pressure. The displacement could be easily reproduced by extreme plantar flexion of the metatarsals accompanied by pressure upward in the long axis of the foot. No attempt was made to unite the tubercle of the scaphoid to the body of the bone. The thin dorsal ligaments were repaired with chromic catgut and the wound closed.

The wound healed without infection, and the patient was discharged two weeks after operation on crutches, with a plaster case extending from toes to knee. The case was maintained for six weeks and then a plate

PENETRATING ULCER OF STOMACH

was made and worn for about four months, when it was discarded because of complete absence of symptoms in the foot.

At the present time, two years and one month after operation, the man has no pain or other disability, and has apparently normal motion and a normal arch.

FRACTURE OF CARPAL SCAPHOID AND DISLOCATION OF SEMILUNAR

DR. JOHN A. VIETOR presented a woman thirty-five years of age, who was admitted to Doctor Pool's service at New York Hospital in February, 1920, with a history of having fallen off a bicycle one year previously and injuring both wrists. For this she was treated in a hospital in New London, where her wrists were put up in plaster-of-Paris for five months. On admission to New York Hospital she complained of pain, tenderness and inability to use the left wrist. Physical examination showed a slight silver-fork deformity of the left wrist with a marked rounded prominence over the anterior carpal region and some tenderness. The maximum tenderness was on the dorsal surface of the wrist just below the middle of the articular surface of the radius. There was no tenderness in the anatomical snuff-box. There was marked limitation of motion especially in flexion. Both adduction and abduction were painful. The diagnosis was unreduced Colles' of left wrist with fracture of scaphoid and dislocation of semilunar on right side. Operation was decided upon under general anaesthesia. The following procedure was followed: Excision of scaphoid for fracture, excision of semilunar for dislocation. Anterior incision on the outer side of the palmaris longus exposing the median nerve. Proximal end of scaphoid and semilunar readily removed. Wound closed without drainage and the forearm and hand immobilized. In twenty-four hours the splint was removed and the patient discharged in five days. She was referred to the out-patient department for baking and massage and active motion. On the nineteenth day after operation there was considerable flexion and extension. There was no longer any limitation in abduction and adduction. She was discharged from the out-patient department in five weeks. Examination made three months later revealed that flexion was normal; at six months there was no limitation of flexion, but slight limitation of extension. There was no loss of adduction, abduction, supination or pronation.

This case is of interest first on account of the relative frequency of the condition. Secondly, it is generally diagnosed and treated at first as sprain. Thirdly, treatment by conservative measures is usually unavailing. Fourthly, dislocation of the semilunar is of frequent occurrence. The fifth and last reason for interest in this case is that good post-operative results followed.

PENETRATING ULCER OF THE LESSER CURVATURE OF THE STOMACH—RESECTION BILLROTH I

DR. RICHARD LEWISOHN presented a man, fifty-two years old, who was admitted to Beth Israel Hospital on February 26, 1923, suffering

from a penetrating ulcer of the lesser curvature. X-ray examination showed a typical Haudeck's niche. Ewald: free HCl, 56, total acidity, 84.

The operation was performed on March 3rd. An upper median incision revealed a penetrating ulcer of the lesser curvature, three-quarters of an inch in diameter. A Billroth I resection was performed, using Haberer's technic. The abdomen was closed in layers without drainage.

Microscopical examination: benign ulcer.

The patient made an uneventful recovery. He was discharged March 26th. Ewald test-meal taken before his discharge showed: free HCl, 0, total acidity, 24.

X-ray examination showed a slight six-hour residue, which will disappear with the return of the tonicity of the stomach.

DUODENAL ULCER—RESECTION BILLROTH II

DR. RICHARD LEWISOHN presented a man, forty years old, who was admitted to Mount Sinai Hospital, February 20, 1923. The patient has complained of severe epigastric pain for the last two years. The attacks were so severe that the patient insisted on an exploratory laparotomy in spite of negative X-ray findings.

Ewald test-meal: free HCl, 32, total acidity, 64.

The abdominal incision through the right rectus muscle revealed a small ulcer (size of a one-half finger nail) on the anterior wall of the duodenum, just beyond the pylorus. The duodenum was bound down by adhesions. After splitting of the hepato-duodenal ligament the duodenum was liberated. The gastric vessels were ligated and the stomach was divided about midway between the cardia and pylorus. The duodenum was dissected away from the pancreas by sharp dissection and divided just below the site of the ulcer. The duodenum was closed in three layers, using the pancreas capsule for the second and third layers. Closure of the proximal end of the stomach in three layers. Posterior retro-colic suture gastro-enterostomy. Closure of abdominal wall without drainage. The patient made an uneventful recovery.

Microscopic examination: benign ulcer.

Ewald test-meal taken three weeks after the operation showed: free HCl, 5, total acidity, 12.

The patient was discharged on March 16th.

RESECTION OF STOMACH IN CHRONIC GASTRIC AND DUODENAL ULCERS

DR. RICHARD LEWISOHN read a paper with the above title, for which see page 507.

DR. GEORGE WOOLSEY said that in regard to gastro-enterostomy, he thought a distinction should be made between ulcers of the stomach and those of the duodenum. He believed Doctor LewisoHN was right in regard to his position as to gastric ulcers. A year ago the speaker wrote a paper which he read in Washington before the American Surgical Association on "The

Choice of Operation for Gastric Ulcer in View of the Late Results." In the last seven years he has done gastro-enterostomy in only 20 per cent. of gastric ulcers operated on. He prefers resection for gastric ulcer, and yet, in looking over the end results of gastro-enterostomy for gastric ulcer, he was surprised to find the results so good, 80 per cent. being good results. This is to be expected where there is pyloric ulcer with marked stenosis, but in one case where the ulcer was near the middle of the posterior wall he got a report nine years afterward that the patient had been well and working hard ever since the operation. Today, ulcers of that kind would undoubtedly be resected. As to the method of resection, Doctor Lewisohn's cases are confined to the two Billroth methods. Doctor Woolsey had never done the Billroth I except in one case, and in that he had to reoperate later on and add a gastro-enterostomy. But when the technic is improved, as in the pictures shown by Doctor Lewisohn, it might offer good results in a selected group of cases. He had used the Billroth II in eight cases, and they included the only mortality he had had in gastric resections; but this was not due to the method but to the condition of the patients. He was inclined to use and recommend the Polya technic of resection rather than the Billroth II; it is easy, takes less time, and the end results are even better in his experience. The part of the stomach that takes the place of the pylorus contracts down after the operation so that examination with the fluoroscope some months later shows what looks like a normal stomach. He had not seen any jejunal ulcers following cases of gastric resection. As to the question of resection in duodenal ulcer, he had done a very few; he hesitated to subject these patients to resection for he believed the ultimate results to be little if any better than after gastro-enterostomy. The bugbear of jejunal ulcer always looms up, but he had not had as much as 3 per cent. occur in his cases; in fact less than 2 per cent. As Doctor Downes said, the Von Eiselsberg's operation gives the largest percentage of jejunal ulcers, but it is seldom used now. For duodenal ulcer gastro-enterostomy is still Doctor Woolsey's operation of choice, and he thought the tendency to condemn it is getting to be a habit. It is like a pendulum which is swinging one way and after awhile it will swing the other. The cases he had operated upon had been followed up very carefully and fluoroscoped and the results have remained for long periods of time very satisfactory.

DR. CHARLES H. PECK agreed with Doctor Lewisohn in regard to the question of gastric ulcer, and at the present time most surgeons seemed to believe they should be excised by one method or another. But he had not applied the same principle to duodenal ulcer for it seemed to him that the majority of these did well with simple gastro-enterostomy. Very few jejunal ulcers are seen, and some of those were due undoubtedly to the type of suture used or to the technic rather than to a tendency for the ulcer to form because only a gastro-enterostomy was done. In the speaker's last series of cases there was only 2.5 per cent. jejunal ulcer. He had never done the Billroth I and

had resected for few duodenal ulcers and then usually when hemorrhage was severe or he was afraid of perforation. He believes that the great majority are healed in a month's time after simple gastro-enterostomy. Gastric ulcer can often be treated by local excision, but one must be sure to destroy the entire ulcer. Doctor Peck had not had much experience with the Polya method of resection, having stuck to the Billroth II in those cases that required resection. He believed that Doctor Lewisohn had struck the right note in urging resection as applied to gastric ulcer, but was inclined to think he was advocating more radical methods than were necessary if he attempts to apply the same principle to duodenal ulcers.

DR. JOHN DOUGLAS said that the ultimate conclusion as to the best operative procedure is going to depend on the late reports from the follow-up clinic in these patients. As Doctor Lewisohn said, every surgeon has a number of cases in which gastro-enterostomy, or gastro-enterostomy with excision has produced results that are not good. He was surprised last fall in following up the cases at St. Luke's at the favorable results following gastro-enterostomy. There were 65 duodenal ulcer and 50 gastric ulcer cases in which various operations had been done. Where gastro-enterostomy was done, in 52 cases of duodenal ulcer only three were failures, and in 28 cases of gastric ulcer one is reported as unimproved. A certain number were not perfect cures, but they were much improved. It was surprising to find this total number of good results, in view of the frequent criticisms of gastro-enterostomy. As far as the after results of these extensive resection operations are concerned, while many of the excision operations are being done at the present time, few have sufficient figures over a long enough period to judge by. Doctor Lewisohn's cases have gone from 1920 to 1923 only. One other point which has not been stressed; an important reason for doing the excision operation for gastric ulcer, either in part or extensively, is the fact that so many of these gastric ulcers are carcinomatous at the time of operation and cannot be so recognized or develop carcinoma later. Two of those at St. Luke's which were at first thought to be cured died of carcinoma of the stomach one or two years later. This extensive resection will prevent that. But it is not necessary to resect half the stomach for a small ulcer in the region of the pylorus, especially if on the duodenal side, that can easily be excised.

DR. ALEXIS V. MOSCHCOWITZ said that even at the risk of being called old-fashioned, he would not like to agree with all of the statements of Doctor Lewisohn. He believed that the whole subject could be summarized about as follows: Even the most enthusiastic internist will agree that the percentage of surgical cures, even after the simpler operations, is about 70 per cent. On the other hand, the most enthusiastic surgeons even claim to curing 90 per cent. The actual truth probably lies somewhere between these two. In other words, the percentage of cures after simple surgical procedures is about 80 per cent. If one analyzes the whole problem, follows the discussions as they take place from time to time at various medical meetings, it is about as follows: The

surgeon is proud of his 80 per cent. of cures, while the internist is proud of the 20 per cent. of surgical failures. After listening to Doctor Lewisohn's paper, it appears to Doctor Moschcowitz that even the surgeon is now proud of his failures.

It appeared to the speaker that it is wrong to group together the ulcers of the duodenum and the ulcers of the stomach. In his experience the ulcers of the duodenum and the ulcers of the stomach near the pylorus, particularly those accompanied by stenosis, are very amenable to cure by the very simple operation such as gastro-enterostomy and pyloric exclusion. In dealing with an ulcer of the stomach far away from the pylorus this method is insufficient, but excision of the ulcer serves very well. Whether or not the method of Haberer, which is really only a modification of the Billroth I, is going to be the last word in the treatment of gastric ulcer, the speaker for the present still had some doubt.

Stated Meeting Held April 25, 1923

The President, DR. JOHN A. HARTWELL, in the Chair

EMBOLUS OF AXILLARY ARTERY

DR. MORRIS K. SMITH presented a woman, fifty-five years of age, who underwent a vaginal hysterectomy for carcinoma of the body of the uterus, March 14, 1923, at St. Luke's Hospital. On the ninth post-operative day at 5.40 A.M., she was seized with sudden severe pain in the left hand running up to the shoulder. She could not move the fingers or hand and noted that the hand was blue. She received two hypodermics for pain before he saw her six hours later. At this time she complained of pain and a feeling of deadness in the extremity. The hand was quite blue, not notably swollen. She could only make the slightest movements with the fingers and wrist. The pulse could be felt in the upper end of the axillary artery just distal to the clavicle but not in the lower axillary or brachial.

Six hours later the pulse could be obtained to the lower end of the brachial, and the color of the hand was much improved. For several days there was a fulness and some sensitiveness in the bend of the elbow where the pulse was lost. Pain lessened and function improved steadily. On the tenth day after the lodgement of the embolus, slight pulsation could be felt in the radial. Two days later the radial pulse was distinct but less than on the other side. At this time motion was free in the hands and fingers. The hand was cool. She had little pain but complained of numbness and prickling.

An X-ray of the chest taken a few days after the development of the complication was negative for aneurism, cardiac or pulmonary pathology.

The past history of the patient is of interest. Twelve years ago she had an appendicectomy at another hospital. Two days later she states that her right leg became white although without pain. This condition, according to her account, gradually extended upward, and on the seventh

day post-operative amputation was done through the thigh. Six years ago she had a herniotomy without mishap.

DR. H. E. SANTEE said that one month ago he discharged a case quite similar to this. The patient had been transferred from the medical service with a history of subsiding pneumonia. A sudden pain had appeared in the right brachial region with loss of pulse, and a cold, anemic hand. Twenty-four hours later sudden pain appeared in the right upper quadrant. The blood count was 18,000, temperature between 100.5° and 101° . There was marked tenderness and rigidity. The question of mesenteric thrombosis or renal infarction was taken into consideration. The urine showed no blood. The condition of the patient precluded active procedure. The pain in the right upper quadrant subsided, and at the end of two and a half weeks pulse appeared in the right radial. As this case progressed it showed a tendency toward diarrhoea and blood in the stools, but in five weeks he was discharged apparently well.

UNREDUCED SEPARATION OF LOWER RADIAL EPIPHYSIS. (2 CASES)

DR. MORRIS K. SMITH presented a lad fifteen years of age who hurt his right wrist in June, 1921. When seen two weeks later in the Out-Patient Department of St. Luke's Hospital, he had a marked silver-fork deformity of the right wrist. He could use the hand quite well and complained principally of the crooked wrist. X-ray showed a backward displacement and tilting of the lower radial epiphysis. Attempted reduction under anæsthesia was entirely unsuccessful. Nine months later the deformity had disappeared clinically and largely radiographically. There was no shortening and no loss of function. Today there is no apparent difference in the wrists.

A second patient was a girl, ten years of age, who fell on her right hand August 5, 1921. When seen in the Out-Patient Department of St. Luke's Hospital, 11 days after the injury, she presented a silver-fork deformity of the right wrist with hyperextension and limited flexion. There was no tenderness. X-ray showed posterior dislocation and tilting of the lower radial epiphysis. Attempted reduction under anæsthesia was unsuccessful. Reëxamination five months later showed a remarkable improvement, and at present the wrists appear the same clinically, while radiographically there is little to show for the old injury.

UNUNITED FRACTURE OF FEMUR

DR. FORDYCE B. ST. JOHN presented a man seventy-five years of age, who had been admitted to hospital on account of obstruction of the colon due to malignant neoplasm, demonstrated to be in the proximal portion of the transverse colon and hepatic flexure. A simple appendicostomy was performed under local anæsthesia with complete relief of symptoms.

He was presented to the society, however, because of the following history:

In 1873, fifty years ago, the patient fractured his right thigh and was admitted to Bellevue Hospital. For two weeks he was

treated in bed with weights attached to the leg by means of a cord running over a pulley at the foot of the bed. At the end of that time, a plaster splint was applied for several weeks and then removed, at which time patient sustained a fall while being lifted into a chair and refractured the femur. From that time on union did not seem quite satisfactory, but patient used it in an active life until a brace was suggested by Doctor Bull. This or similar braces he has worn ever since with but little discomfort and interference with his work.

He now presents marked shortening, pseudoarthrosis and a rather interesting X-ray. The X-ray shows no evidence of bony union, marked overriding and bone atrophy. It is of further interest that even with the fibrous union he walks without the brace although with a marked limp. It is not practical, however, for him to carry on without the brace. It is of much historic and scientific interest to study a fracture with pseudoarthrosis fifty years after the injury.

A second patient presented by Doctor St. John was a man, twenty-six years of age, who was admitted to the Presbyterian Hospital, September 19, 1921. Two months before admission he had sustained a fracture of the left femur, tibia and fibula. For three and one-half weeks he was treated by traction in bed, at which time traction was removed and a plaster spica from umbilicus to toes of left foot applied. He was then allowed to go to his home. Two months after the injury the plaster was removed and marked shortening with non-union of femur, tibia and fibula noted. He was then referred to the Presbyterian Hospital.

Upon admission he presented a marked deformity at the middle of the left thigh, where the lower end of the upper fragment of the femur was readily felt subcutaneously with apparently no musculature intervening. There was a shortening of approximately 10 cm. and clinically no union at the site of fracture. Angulation mesially existed in the lower third of the left leg at the site of fracture of tibia and fibula. At this point there was also motion present but to a lesser degree than in the femur. Passive motion at the knee was limited to 10° (170° - 180°). There was no active motion at the knee. There was complete loss of function in attempting to dorsi-flex the foot at the ankle or extend the toes. The whole extremity showed marked atrophy, the skin was in fair condition; there were no areas of ulceration or necrosis.

Treatment.—Four days after admission skeletal traction was instituted by means of ice tongs with the thigh and leg in overhead suspension, the leg being increasingly flexed and extended on the thigh by the patient. Skeletal traction maintained for 67 days, 35 pounds for first 10 days, then 25 and eventually 20 pounds as an average. Simple suspension, with knee motion encouraged, following this for 60 days, then all apparatus removed with patient in bed for 2 weeks, following which he began using crutches. Six months after admission, 8 months after injury, patient was walking well on crutches and was discharged. Massage every other day was carried on during the above period.

Now 21 months after injury:—the patient's economic status is

100 per cent., *i.e.*, he carries on his work as an automobile mechanic uninterruptedly.

The case is presented as a long interval result in a complicated multiple non-united fracture of the femur, tibia and fibula in which the femur fracture consisted of four fragments, the largest about 10 cm. long between and unattached to the upper and lower extremity of the bone, and as another demonstration of good functional result with poor anatomical position. One feels that the decision to use skeletal traction is well justified by the result.

DR. H. H. M. LYLE spoke of a similar case with a double fracture of the femur that he treated ten years ago. He had not seen the man since 1914, until he turned up the other day with an old gunshot wound of the arm. Skeletal traction with 50 pounds weight had been applied and a perfect functional result obtained. This man had gone through the late campaign with the First Division until he was wounded in the right arm during the Argonne-Meuse offensive.

DR. JOHN A. HARTWELL hoped that the case reported by Doctor St. John would show the wisdom of utilizing to the utmost methods which grant to the patient good functional use of the limb at the least possible risk.

FRACTURE OF SURGICAL NECK OF HUMERUS

DR. JAMES N. WORCESTER presented a man, aged thirty years, who was admitted to Reconstruction Hospital, November 14, 1922, with this history: Six weeks before admission he fell a distance of three stories. He was taken to Bellevue. A diagnosis was made of a fracture of the surgical neck of the humerus. He was there for six weeks and discharged, at his own request, on November 13. While there he was treated with suspension and traction. He says that his arm was at an angle of about 45 degrees abduction and the forearm was suspended straight up and down.

Physical examination, November 15, showed a marked prominence of the shoulder with a concavity below the shoulder at the outer surface. Active motion is very limited with practically no abduction or external rotation: Passive motion is limited to a very few degrees in the same planes. Union is apparently solid.

X-ray shows fracture of the surgical neck of the right humerus, the upper fragment markedly abducted, with greater tuberosity in contact with acromion process. The fractured surface points almost directly outward. The lower fragment is displaced inwardly and anteriorly and there seems to be no contact between the two fractured surfaces. There is considerable callus, with lateral union.

On account of the apparent impossibility of attaining rotation or abduction with the existing mal-union, open operation was decided upon.

At operation, November 20, 1922, the position of the fragments was found to be exactly as in X-ray. A considerable amount of soft callus was present. On chiseling the fragments apart, it was found that, with the arm in abduction and marked external rotation, the two fractured surfaces were brought into contact.

Post-operative Treatment.—The arm was suspended in a position of extreme abduction and external rotation and ten pounds of traction used.

X-ray of November 27 shows that there is still a slight internal displacement of the lower fragment, but that the line with the head is sufficiently good to insure proper motion. The patient was allowed out of bed on the 24th day and was discharged December 20, 30 days after operation. Active motion was started immediately after operation, and heat and massage were used throughout. On discharge from the hospital he still had some limitation of motion.

The case was shown, not to illustrate the satisfactory result, but to emphasize the importance of marked abduction and external rotation in the treatment of high fractures of the humerus. Also, to show the remarkably quick union which is obtained under the suspension and traction treatment.

TENDON TRANSPLANT FOR DROP WRIST

DR. JAMES N. WORCESTER presented a man, aged twenty-eight years, who was admitted to Reconstruction Hospital, February 25, 1922, with a history that in September, 1917, while in the army, following a typhoid inoculation given in his right arm, he had a severe infection. This was operated on, immediately following which he noted that he could not extend his wrist. Following this, he had nine operations for osteomyelitis and soft part infections.

Examination shows multiple scars and sinuses about elbow, with complete ankylosis of the elbow. X-ray shows complete bony ankylosis, with marked involvement of the shaft of the humerus.

These sinuses had been treated and operated on at several times and on several occasions had been entirely healed, only to break out again. A large amount of scar-tissue and infection have precluded a search for the ends of the divided musculospiral nerve, so it was decided to do a tendon transplant for the improvement of the drop wrist.

April 11, the tendon of the flexor carpi radialis was cut across at its insertion and brought around to radius through a subcutaneous tunnel and sutured with silk to the extensor longus pollicis and the extensor to the index finger. A similar procedure with the flexor carpi ulnaris and this tendon sutured to the extensors of the third, fourth and fifth fingers. Wrist was mobilized in extension for 12 days, when active motion of the fingers was started. A cockup splint is still being used.

This case was shown simply to illustrate the very early adaptation of the muscles to their new use.

SPLENOMEGALY

DR. ALLEN O. WHIPPLE presented a girl, aged eleven years, who was admitted to hospital, September 22, 1922, and discharged, December 24, 1922, whose chief complaint was vomiting of blood. Her childhood had been normal in every way until three years ago, when she had two attacks of vomiting of blood. No digestive disturbances. Free interval until eight months ago when she vomited blood in fairly large amount on three occasions. Another free interval from all symptoms until five days

before admission, when she had in two days five severe hemorrhages from the stomach. These hemorrhages all came on out of a clear sky without any preceding nausea, pain or other warning. She vomited up to one pint at a time, of dark blood, sometimes in clots. No pain, cramps or diarrhoea. No purpuric spots nor bleeding from mucous membranes. Gastro-intestinal series taken at the Mt. Sinai Hospital in January, 1922, showed no lesion. No habits of swallowing hair or foreign material.

Physical Examination.—Very anemic girl of eleven. Hæmoglobin 32 per cent. Spleen was palpable, soft. Wassermann negative. X-rays of chest and abdomen and gastro-intestinal series negative. No increased fragility of red cells. She was on the medical side in this hospital for several weeks, and while under observation she had several severe hemorrhages. Preceding each hemorrhage the spleen was markedly enlarged, and with each hemorrhage decreased in size. Her own physician felt that her bleeding was from varices in gastric veins, independent of the spleen, and opposed operation, but after several hemorrhages, and all conservative treatment failing, he consented to an exploratory with the request that the tributaries, namely the vasa brevia, be ligated. The attending physicians and surgeon in the hospital felt that there was some intermittent blocking of the splenic vein supply causing a recurrent hemorrhage and advised splenectomy.

Operation.—December 11, 1922, exploratory celiotomy; left rectus incision. Following pathology was noted: All tributaries to the hepatic, gastric and splenic veins were involved in a uniform dilatation and engorgement. The veins around the cardia, pylorus and gall-bladder, on the latter appearing as a collection of large varicosities on the fundus of the gall-bladder, were markedly dilated and engorged. The tributaries to the splenic vein over the spleen and left gastro-epiploic vein were particularly dilated. A very remarkable feature noted was the absence of involvement of any of the tributaries to the mesenteric veins. There was no engorgement of these veins. No evidence of fluid in the abdomen or of congestion of the intestine. Situated in the gastro-hepatic omentum directly beneath the peritoneum and apparently anterior to the common duct, was a very large vein apparently draining the tributaries from the stomach and gall-bladder. There was no thrombosis in the vein itself but it seemed to empty with difficulty into the portal fissure as if there were obstruction higher up. From the findings it seemed logical to conclude that the mesenteric vessels emptied independently and without obstruction into the portal fissure and were not connected with the splenic lymphatic veins. Splenectomy on ligation of the splenic vein with the above findings did not seem to offer a sufficient ground of relief to be carried out, although it was thought that splenectomy might take off some of the burden of the portal venous return. Ligation of the vasa brevia of the stomach was considered a hazardous and hopeless procedure. The conclusion reached was that there was some unknown obstruction to a large part of the portal circulation from the stomach, spleen and gall-bladder.

Post-operation Course.—Entirely uneventful. At no time was there vomiting or distention. On discharge on the twelfth day, spleen was just

palpable at the costal margin on deep inspiration. Wound healed by primary union.

Follow-up.—Two months, no symptoms referable to her abdomen; no hemorrhages. Scar linear firm. Red cells 4,500,000, hæmoglobin 70 per cent.

A second case presented by Doctor Whipple, was a woman, aged thirty-six years, married, three children, housewife, who during the past four years has had attacks of dyspnoea and palpitation. During the past six months she has had frequent attacks of precordial pain with palpitation, dizziness and asthenia brought on by exertion or stress. Came to the hospital because of attack of four days of severe pain in the left upper quadrant. Examination showed heart enlarged to the right and left. All of the signs of mitral stenosis and insufficiency. Blood pressure 120/80. Spleen palpable 3 cm. below costal margin, very tender. Wassermann negative. Hæmoglobin 90 per cent. Red cells 4,900,000, white cells, 8,600, polymorphonuclears 71 per cent.

Repeated blood cultures during her stay showed no growth.

Aside from the possibility of an active endocarditis, the combination of mitral stenosis and enlarged spleen might be due, first, to mitral stenosis with auricular thrombi and embolism in the spleen; second, a healed endocarditis with residual enlarged spleen as described by Libman; third, mitral stenosis with independent perisplenitis. The second of these is the most probable. The usual associated kidney damage is not borne out by urinalysis. The spleen is easily palpable and persistently painful and tender. There have been no changes in her heart murmurs. No petechiæ have been found. Blood cultures have been negative. Temperature not elevated.

On December 2, at a time when she had been free from symptoms for several days, following an examination of her spleen she was seized with violent pain and tenderness in the spleen. The tender mass was definitely proven to be spleen by colon inflation and by X-ray. She continued to have exacerbations of pain and tenderness in her spleen, her heart condition improving, however, with rest. Following a very severe attack of pain on December 5 she insisted that an operation be performed, and on the urging of the medical attendings a splenectomy was decided upon.

January 6, 1923, a complete splenectomy was done under gas and oxygen anæsthesia, 43 minutes. Incision, left rectus. The spleen was twice the normal size. Peritoneal surface at the lower pole was studded with white granular thickenings of the subperitoneal tissue. There was no general perisplenitis. There were no thromboses of the splenic vein or its tributaries. The stomach, left kidney, colon and pancreas felt and appeared normal. The liver and bile passages were normal. Splenic vessels were not atheromatous. Hæmostasis complete. Closure without drainage. Pathological report: Chronic splenitis, perisplenitis.

On the fourth day patient developed a left lower lobar pneumonia, group IV, lasting five days. Otherwise her convalescence was smooth. She went home on the twentieth day.

Following operation patient has had no complaints referable to her splenic area. She still has symptoms of cardiac insufficiency. Following

an attack of dyspnoea and palpitation she was readmitted on February 1 to the medical side for observation.

A third case presented by Doctor Whipple was a man, aged twenty-four years, who was admitted to hospital, August 14, 1922, with recurrent jaundice, fever; pain in left upper quadrant of abdomen.

No history of nosebleeds or hæmoptysis. No hemorrhages from mucous membrane. Spleen has always been enlarged since boyhood. He was in this hospital ten years ago, at which time enlarged spleen and increased fragility of his red cells were noted. At the age of six years he had a fright at which time he had a severe attack of vomiting, weakness and fever. Since then he has always been pale and has had recurrent attacks every summer, increasing in severity with the following order of symptoms. First, fever; second, vomiting of brown material; third, jaundice; fourth, weakness. He remains in bed 3 to 5 days, up and about in 5 to 10 days. In June, 1921, he had three severe attacks. Following each attack he noticed that his scleræ were jaundiced. There was no pain associated with these attacks. In July, 1921, he was attacked with fever, malaise and marked asthenia. He was taken to the Harlem Hospital. During examination, following a palpation of his spleen, he was taken with very severe pain and subsequent tenderness in the region of the spleen. This persisted after his return to his home. In July, 1921, he was brought to the Presbyterian Hospital, at which time the spleen was found enlarged and exquisitely tender. He was definitely jaundiced. Hæmoglobin 50 per cent. Blood showed a very definite hæmolysis at 0.5 saline solution, that is fragility of his red cells was markedly increased. Stools were not clay-colored. He was given two transfusions. Pain and tenderness increased in the left costo-vertebral angle, and a *diagnosis* of perinephritic abscess was made. This was opened and about 250 c.c. of thick, yellow pus evacuated, showing a non-hæmolytic staphylococcus aureus.

Patient recovered without complications and left the hospital in two weeks. One month after leaving the hospital he developed jaundice, and this persisted for the following year until readmission to the hospital, August, 1922, when he came in for a splenectomy. Spleen was markedly enlarged at that time, going down in the inter-crystal line and extending to within 3 cm. of the umbilicus. His red blood-cells still showed a definite hæmolysis of 0.5 saline solution; hæmoglobin 51 per cent. Wassermann negative. Landsteiner amboceptor reaction negative.

Operation.—On August 14, 1922, splenectomy was performed under gas-ether anæsthesia (40 minutes) with the following findings: Liver appeared normal in size and texture. No cirrhosis; gall-bladder moderately distended but emptied easily. No stones felt in the gall-bladder or ducts. Left kidney in the region of the former perinephritic abscess palpated easily and felt normal in size and position. There were a few adhesions between the spleen and the diaphragm but none which appeared related to the previous operation. The spleen was large, measured 21 x 13 x 6 cm., weighed 720 gms., was much softer in consistency than those with Banti's disease or chronic splenitis. The

vessels were not atheromatous. There was no collateral circulation; no ascites.

Procedures, Left Rectus Incision.—Balfour technic. Spleen removed without hemorrhage. Three rubber-dam tubes were placed in the region of the hepatic.

Pathological Report.—Splénomegaly; hæmolytic jaundice.

Post-operative course was very smooth; no complications. Red cell count showed a progressive increase, but the hæmolysis persisted and was still present two months after operation.

Five months after operation his condition was excellent. Liver was still palpable at the costal margin. Patient working at full capacity. Jaundice had entirely disappeared and he has had no recurrence of former symptoms.

DR. WILLIAM A. DOWNES referred to a case in which he removed the spleen about three years ago. The patient was a child nine years old. He had another hemorrhage one year after operation and a second one year and a half later, and the mother wrote a letter in December saying that he had died as a result of a third hemorrhage. The spleen was only moderately large. The pathological report was Banti's disease.

DR. JOHN A. HARTWELL described a similar case in which repeated hemorrhages took place and prior to each hemorrhage there was a marked engorgement of the spleen. After the hemorrhage the spleen would become much smaller, but never return to the normal size. A splenectomy was done with apparent cure, patient having been kept under observation for a considerable period. At operation it was noted that the veins were dilated very much as in Doctor Whipple's case, but not to so great a degree. The pathology of the spleen showed a splenitis only.

DOCTOR HARTWELL reported a second case with pain very similar to that in the case reported by Doctor Whipple. A very careful study of this case failed to reveal any pathology except a large freely movable spleen. The pain was severe, paroxysmal, cramp-like in character. At times there seemed to be evidence of a chronic intestinal obstruction as determined by dilated small intestine with visible peristalsis. X-ray examination failed to show any evidence of obstruction. At operation no abnormalities could be found except a large movable spleen. Its pedicle was so long that the entire organ was easily delivered from the abdomen. No evidence that it was responsible for an obstruction could be established. Largely on the advice of Professor Coryllos of Athens a splenectomy was done. It showed no pathology other than a splenitis and perisplenitis, it having been attached to the diaphragm by a few delicate adhesions. Patient made an entirely satisfactory recovery. She was relieved of all pain almost immediately and an observation extending over two months failed to reveal any recurrence of the symptoms.

DOCTOR WHIPPLE said he did not do a splenectomy because such a large area was engorged and the large veins communicating with the liver were tremendously distended as were the vessels of the lesser curvature. This

seemed to rule out the prevention of further hemorrhage by splenectomy. In regard to the case with pain, he did not mention that the pathology of the spleen was negative except for enlargement; there were no thrombosed vessels; there was nothing to explain the symptom of pain. The speaker had hoped that he would get an explanation for this from the discussion. In looking up the literature on the subject he could find no satisfactory explanation for the cause of the pain.

RECURRENCE OF INGUINAL HERNIA AFTER OPERATIVE TREATMENT

DR. ALBERT S. MORROW read a paper with the above title, for which see page 524.

DR. FRANZ TOREK said that in his opinion faulty technic was responsible for more recurrences than any other one cause. Next in frequency comes either the failure to repair the parts concerned in direct hernia, when operating for oblique hernia, or *vice versa*, though less frequently, the failure to investigate whether an oblique sac exists when operating for direct hernia.

The speaker wished to take exception to one statement made by Doctor Morrow when he said that none of the operations devised since the time of Bassini embodied any new principle. The operation he had been practicing for the past seventeen or eighteen years, and the most recent publication of which appears in the *ANNALS OF SURGERY*, July, 1919, is based on an element in the anatomy of oblique inguinal hernia, which has theretofore been ignored, *viz.*, the fact that at the opening in the transversalis fascia which we call the internal ring the sac finds its way out, not above or below the cord, but in the midst of it, *viz.*, between the vessels and the *vas deferens*. Viewed from within, the vessels are seen to approach the internal ring from above, the vas from below, and these two structures meet at an angle affording the peritoneum an entering wedge to insinuate itself and to protrude forming a hernial sac. After it has found its way out, the sac may lie in any other relation to the cord, but the important thing is the relation of vessels, sac, and vas at the point of exit, and upon a study of this condition is based the underlying principle of Doctor Torek's operation, namely the abolition of this wedge which favors the production of a hernia. The vas, after having been freed from connective tissue, is placed in the lowermost angle of the internal ring, and the vessels, after a similar liberation from all adventitious tissue, is placed in the upper corner, the space between the two being obliterated by the reconstruction of the abdominal wall. Thus the original wedge-shaped arrangement is converted into a firm, square buttress. This method, if correctly performed, assures against the recurrence of an oblique hernia. The speaker considered that this method certainly did embody a new principle in the operation for inguinal hernia.

As to direct hernia, he had called attention in the same publication to the possibility of mobilizing to some slight extent the rectus muscle by separating

the upper layer of its sheath, that formed by the aponeurosis of the external oblique, from the next layer which is derived from the internal oblique. This separation is performed at the pubic end of the muscle. The unopened rectus sheath can thus be brought into approximation with Poupart's ligament under somewhat less tension than is otherwise possible.

Some degree of tension, however, often remains in the lowest part of the plastic, for about half an inch from the pubis. In order to avoid failure due to premature absorption of sutures or to the reopening of knots, which is apt to occur when an absorbable suture, under tension, has become saturated with lymph or other body fluids, the speaker employed non-absorbable material where there was tension. This choice of material is, of course, not a new idea. Others have expressed themselves in its favor, some employing silk, others silver wire. Brandao of Rio de Janeiro, who has recently published the speaker's operation in the Portuguese language, gives preference to aluminium bronze.

There are also many details on which the speaker lays stress, but for those he referred to the published article. The operation requires a little more time and minute attention to technical details, but it offers those who are no longer fully contented with 10 per cent. of recurrences, satisfactory results with a percentage of recurrences that is almost negligible.

DR. H. H. M. LYLE said he would like to emphasize what the speaker had said about suturing without tension. In 1920, he wrote an article calling attention to the value of position in the operative treatment of inguinal hernia (S. G. O. November, 1920, p. 529).

In order to insure firm union, all tension must be avoided. Tight suturing means tissue tension, impairment of nutrition and the possibility of replacement of fibrosis. In the operative treatment of inguinal hernia this elementary procedure of placing the parts in a position of muscular rest simplifies the closure, aids union and assures comfortable convalescence. This principal was doubly important in recurrent cases.

DOCTOR LYLE said, regarding the value of Gallie operation in bad recurrent hernia, that within the last eight or nine months he had several cases in which it was necessary from a humanitarian standpoint to make an attempt to repair the hernia. These recurrences were in individuals who had been refused operation by competent surgeons and in whom the truss makers could not control the hernia. Doctor Lyle had been delighted by the results obtained by using free transplants of fascia as living sutures in the treatment of these difficult cases.

DR. J. P. HOGUET said that this question should come down to a few principles. Surgery has come to a stage where it can recognize that there should not be such a thing as recurrent inguinal hernia in children. The speaker has come to the conclusion that if a case is infected it is hopeless as far as recurrence is concerned. If there is infection there will be recurrence. The question of direct hernia is the question of pathology in the inguinal

region, and there is no question but that enough importance has not been laid on the structure of the muscles there. Concerning this, a few broad rules can be laid down. Many direct inguinal hernias can be cured with the ordinary Bassini operation with transplantation of the cord. Those are the cases where there is a strong conjoined tendon. Second, in the case where the whole canal bulges out one will find a wide bellied rectus muscle, and that is ideal for rectus transplantation. In the third type there is a narrow, thin rectus muscle, and that the Bassini operation with suture of the reduplicated aponeurosis will cure. The speaker did not agree with Doctor Morrow that the proportion of cases that cannot be operated upon is so large. Many of them with direct hernias can be cured with any one of these operations.

DR. ALFRED S. TAYLOR said "there is something after operation which has to do with the prevention of recurrence." It was brought to his attention by Doctor Bull, who asked him to tabulate 300 cases which he (Doctor Bull) had done by the Bassini method. All these patients were operated upon by Doctor Bull, who used the same method and same suture materials in all of them. He started by keeping the patients in bed for ten days and got from 40 to 50 per cent. recurrences. He then increased the length of time in bed and there was a reverse decrease in the percentage of recurrences. When they were kept in bed for twenty-one days there were no recurrences except in cases of wound infection. He considered the time element in bed an important thing in the prevention of recurrent hernia.

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PNEUMOVENTRICLE OF THE CEREBRUM FOLLOWING FRACTURE OF THE SKULL*

By FRANK R. TEACHENOR, M.D.,

OF KANSAS CITY, MO.,

ATTENDING NEUROLOGICAL SURGEON, KANSAS CITY GENERAL HOSPITAL ATTENDING SURGEON,
CHRISTIAN CHURCH HOSPITAL.

PNEUMOVENTRICLE of the cerebrum of traumatic origin is a rare condition, which justifies the report of the following case:

H. P. (Kansas City General Hospital No. 2353, 1922.) Age sixty. Huckster. Entered the hospital September 10, 1922, in a drunken, semiconscious and delirious state, having been found on the sidewalk by the police. There were no bruises or lacerations about the head or face. There was a profuse discharge of blood-tinged cerebrospinal fluid from the right ear. Frequent vomiting. The patient had no recollection of being injured. It was assumed that in his drunken state he had fallen and struck his head on the sidewalk.

Previous History.—Drank alcohol in large quantities. Fracture of the skull in 1921, (Kansas City General Hospital No. 120, 1921). Radiograms of the skull show a fracture identical in location with the present fracture. There was hemorrhage from the nose and right ear.

Physical Examination.—Patient well developed and nourished, age 60. Marked alcoholic intoxication. Blood-pressure, systolic 110, diastolic 80. Pulse 68, regular and full volume. Respiration 20, deep and regular. Temperature, 97.8.

No lacerations or contusions on the head or face.

Eyes. Right pupil dilated, left contracted. Both reacted to light. Ocular fundi normal. Ocular movements normal.

Ears. Copious discharge of blood-tinged cerebrospinal fluid from the right ear for about twelve hours. Small perforation of the right tympanic membrane. Hearing diminished in both ears, more marked in the right.

Nose. Normal, no hemorrhage.

Neck. Pronounced jugular pulsation.

Thorax and abdomen normal.

Extremities normal, with the exception of scars on both legs from old varicose ulcers.

Reflexes considered normal throughout.

Cerebrospinal fluid blood-tinged. Intraspinal pressure 12 mm. of mercury. Spinal Wassermann four plus positive.

Blood Examination.—Hemoglobin 85 per cent. Erythrocytes 3,000,000. Leukocytes 4800.

Radiograms of the skull on September 11, 12 and 13, show a linear fracture beginning in the posterior superior part of the right parietal bone, extending

* Read before the Western Surgical Association, December 9, 1922.

downward and forward through the external auditory meatus. No evidence of depression. The interesting feature in the plates is the fact that the lateral cerebral ventricles are shown distended and filled with air. The lateral views show the entire lateral ventricles distended with air and an area of slightly



FIG. 1.—Antero-posterior view showing the left lateral ventricle widely distended with air and displacing the right ventricle, which is not so widely distended, to the right. The inferior horn of the left ventricle is shown distended with air, but the right inferior horn is invisible.

diminished density in the right middle cranial fossa probably due to air. The antero-posterior view shows the left lateral ventricle widely distended and displacing the right ventricle, which is not so widely distended, to the right. The inferior horn of the left ventricle is shown distended with air, but the right inferior horn is invisible. This is probably due to the fact that the air has not become evenly distributed between the two ventricles after changing the head from the lateral to the antero-posterior position. Air is not seen in the right middle fossa in the antero-posterior view. Radiograms taken September 29, eighteen days after the injury, show practically a complete absence of air in the ventricles

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Progress. The day following the injury the patient said he felt well and asked to be discharged. He said he had no headache, but he vomited occasionally.

On the third day a partial facial palsy developed, peripheral in type. There was slight increase in the tendon reflexes of the lower extremities. Babinski reflex positive, bilateral. Abdominal and cremasteric reflexes diminished. No loss of sensation. Pupils equal and reacted to light and accommodation. Slight headache, no nausea or vomiting. Slight dizziness and some mental confusion.



FIG. 2.—Lateral view showing the distended and air-filled lateral ventricle.

Optic discs showed no evidence of compression. The dizziness and mental confusion gradually subsided over a period of about three weeks, and the reflexes returned to normal. Spinal pressure normal, September 29. There was a gradually increasing diminution in hearing in the right ear.

He was discharged from the hospital, at his request, October 23, 1922. He was clear mentally, no dizziness and no headache. There was partial paralysis of the right seventh cranial nerve, and complete paralysis of the auditory portion of the eighth nerve.

Diagnosis. Pneumoventricle cerebri, following fracture of the right parietal and temporal bones, the fracture passing into the right auditory meatus and petrous portion of the temporal bone. Delayed paralysis of the right eighth cranial nerve, with partial paralysis of the right seventh cranial nerve.

A review of the scant literature on the subject brings out some interesting features of this condition. It has been associated with intracranial

aerocele, and the two conditions are so closely associated as to justify simultaneous consideration.

Skinner, Holmes, May, Glenard and Aimard, Barbe and Glenard, and Horrax have reported cases of intracranial aereocles. In each of these cases the intracranial aereocle followed fracture of the frontal bone with involve-

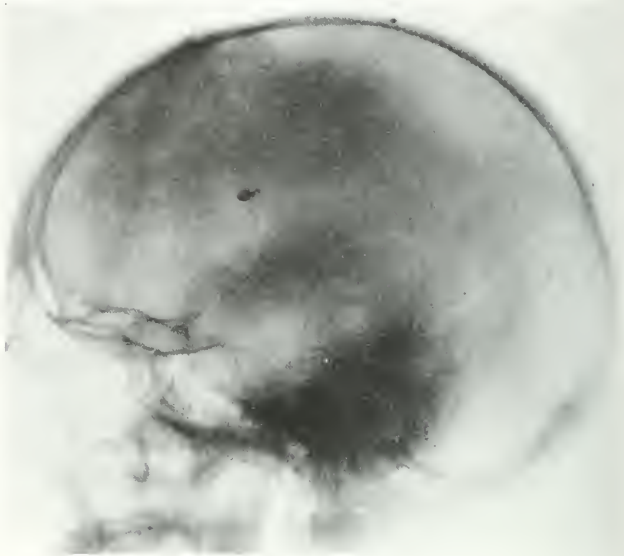


FIG. 3.—Lateral view taken eighteen days after the injury, showing that the air has been absorbed from the ventricles. The line of fracture is plainly visible. Radiograms by Dr. L. A. Marty.

ment of the frontal sinus. This would lead one to assume that the air gained entrance to the intracranial spaces by way of the frontal sinus.

LUCKETT, in 1913, claims to have reported the first case of traumatic pneumoventricle cerebri. The patient had a fracture of the frontal bone involving the right frontal sinus. Early radiograms showed no air in the ventricles, and he was discharged from the hospital. About two weeks following the injury the patient sneezed, had a severe pain in the head and a flow of about a cupful of clear fluid from his nose. Two days later he reentered the hospital mentally confused, with headache, vomiting, optic neuritis and partial aphasia. Right subtemporal decompression showed a slight meningitis. Ventricular puncture brought forth a few spurts of air. A suboccipital opening was made to drain the cisterna magna, and on entering the cisterna magna cerebrospinal fluid containing bubbles of air escaped. The patient died three days later. Autopsy showed air in the ventricles, and also a laceration of the right frontal lobe communicating between the fracture in the right frontal sinus and the anterior horn of the

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lateral ventricle. It was assumed that the sneezing forced air from the frontal sinus, through the laceration in the frontal lobe, into the anterior horn of the ventricle.

LUCKETT, in 1917, reported a second case with fracture of the frontal bone involving the orbital plate. As in the first case, no air was found in the ventricles and the case was discharged from the hospital, to return a week later with mental confusion, dizziness and headache, and signs of intracranial compression. Radiogram showed air in the cerebral ventricles. Right subtemporal decompression showed only slight signs of increased pressure, and air was demonstrated by ventricular puncture. A few days after the operation only a trace of air was found in the ventricles. No history of sneezing. The patient recovered.

POTTER, in 1919, reported a case of hydropneumocephalus with air in the ventricles. The patient was injured 19 days before coming under his observation. There was no loss of consciousness. Radiograms of the skull showed a stellate, comminuted fracture of the frontal bone centring about the right supraorbital notch. Intracranially, beneath the site of fracture, was evidence of a gas accumulation in shape and size comparable to a hen's egg. The patient had headache for a week and dizziness on bending the head forward. Two weeks later there was considerable increase in the size of the gas chamber and the lower half was filled with fluid. On changing the position of the head the fluid level changed, and there was an audible splash. At this time the lateral ventricle was partially filled with air. The exact date of the absorption of the air was not known, but no air was found on the 56th day. The patient recovered. It was assumed that the air chamber became filled with fluid as the air was absorbed. Potter believes that these air chambers are a potent factor in the formation of intracranial "traumatic cysts."

HOLMES, in his report of a case of intracranial arachnoid cyst, mentions a case of Doctor Walter J. Dodd, in which there was air in the ventricles. The case was not reported.

Dandy, in his work in ventriculography, states that there are no deleterious results from injecting air into the cerebral ventricles. Headache occasionally follows, but this is readily relieved by ventricular puncture. The headache is due to an increase in intraventricular and intracranial pressure, rather than to the presence of the air, otherwise the ventricular puncture would not give relief. Dandy also says the air is slowly absorbed day by day, and is absorbed in about two weeks in cases of hydrocephalus.

It is probable that air in the cranial cavities and spaces causes symptoms only by increasing intracranial pressure. It may also act as a carrier of infection. Potter believes that air in the cranial cavity is a potent factor in the formation of traumatic intracranial cysts. In his case he observed the air being absorbed within the intracranial gas chamber and fluid replacing it. The same process was observed by Glenard and Aimard in their case, covering a period of two months. Barbe and Glenard report the autopsy findings on this patient, who died of another condition nearly a year later. They found a cyst at the site of the original air cavity containing 25 c.c. of fluid.

The period required for absorption of the air varies from a few days to more than two months. In Lockett's second case there was only a trace

of air in the ventricles in radiograms taken a few days after its appearance; however, most of the air was removed during the operation. In the case reported by Horrax, the aerocele was not discovered until it came under his observation about a month after the injury and operation. The air was absorbed sometime within the next seven weeks. From the cases reported, it seems that the air was absorbed from the ventricles more rapidly than from cavities elsewhere in the cranial cavity. In the case reported by Skinner, the air was aspirated four weeks after the injury. Chemical analysis showed it to be mostly nitrogen.

The route of entrance of air into the ventricles in Luckett's first case was proven at autopsy to be by way of a laceration in the right frontal lobe communicating between the fracture in the frontal sinus and the anterior horn of the lateral ventricle. This is apparently the only case reported of pneumoventricle to come to autopsy.

Potter suggests that the probable route of travel of the air in his case was by way of the subarachnoid space to the cisterna magna, thence by way of the foramen of Magendie, fourth ventricle, iter, third ventricle and the foramina of Munro to the lateral ventricles. This seems a roundabout way, but the finding of air bubbles in the fluid of the cisterna magna in Luckett's first case proved that air travelled such a route as far as the cisterna magna.

The author wishes to offer a probable route more applicable to his case, which is the only reported case in which the fracture was through the external auditory meatus and the petrous portion of the temporal bone. As the cerebrospinal fluid escaped from the right ear it is assumed that the air gained entrance by the same route. Fractures in this region tend to cross the floor of the middle cranial fossa to the floor of the sella tursica. The floor of the third ventricle lies in this region. The floor of the third ventricle in the post-chiasmal region and about the tuber cinereum is very thin, and the infundibular process of the third ventricle passes well into the pituitary stalk. A fracture in this region, with a sudden displacement of the brain placing these tissues under tension, might easily lacerate into the third ventricle, and permit an egress of ventricular fluid and an ingress of air. The air would then readily pass through the foramina of Munro into the lateral ventricles. This route has not been established, but is offered as a plausible and probable route.

Air was forced into the ventricles in Luckett's first case during an attack of sneezing. Compression of the air may have been a factor in the case of intracranial aerocele reported by Skinner, his patient being injured in an explosion. The author's case was in a wild delirium during the first night and had to be restrained. In resisting restraint air may have been forced through the eustachian tube and middle ear into the middle fossa.

Of the four cases of pneumoventricle reported in the available literature there was one death. This death was from meningitis. The result was not stated in the case of Doctor Dodd. There were four deaths in the six cases

of intracranial aerocele. Three were from meningitis, and one as a direct result of the injury.

As the presence of air in the cranial cavity or ventricle does not in itself cause any deleterious effects, the treatment should be directed against its most common complications:

1. Meningitis.
2. Intracranial compression.
3. Its tendency in intracranial aerocele to the formation of cysts by replacement of the absorbed air with fluid.

Aseptic and antiseptic treatment of the wound of entrance of the air is of prime importance. Air in the ventricles is rapidly absorbed, and in the absence of other indication for operative measures, notably increase of intracranial pressure, may be ignored. In the cases of intracranial aerocele the air seems to be absorbed more slowly, and on account of its tendency toward cyst formation, should be aspirated or drained. Drainage would also tend to lessen the danger of meningitis. The drainage or aspiration, if done, should be done early. The accompanying skull fracture and brain injury will usually indicate the type of treatment to be employed.

Pneumoventricle cerebri, and especially intracranial aerocele, probably occur more frequently than the literature indicates.

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POST-OPERATIVE INFECTIVE PAROTIDITIS*

By WILLIAM H. FISHER, M.D.

OF TOLEDO, OHIO

It is the intent of this paper to deal with the various grades and types of infection that occur in the parotid following operations upon distant parts of body.

In order to present a clearer picture of the various phenomena that obtain in the infective inflammations, the following classification is adopted. This classification is based upon the clinical manifestations that occur, representing, as they do, varying degrees of severity in the infective processes and the resultant systemic reaction.

Classification.—(1) Acute parotitis, or simple inflammation. (2) Acute suppurative parotitis. *a* Circumscribed parotitis or lobular parotitis. *b* Diffuse parotitis. (3) Gangrenous parotitis.

Post-operative inflammation of the parotid is infective in character. Though the case may be a clean operation, foci of infection exist somewhere in the body and bacteriæmia exists in a greater or lesser degree. The resistance of the patient, the susceptibility of the gland, the potency of the infective agent, will determine one or the other of the types that will develop.

(1) Acute parotitis or simple inflammation of the glands follows operation from three to five days. It is represented by malaise slight elevation of temperature and pulse rate, stiffness of side of face, swelling of gland anterior to ear, with pain on pressure. Under proper treatment this inflammation subsides in three or four days without any untoward effects. It is exceedingly common and seems to have been more prevalent in the late epidemic of contagious and infectious diseases.

Illustrative Case.—Anthony D., age twenty-eight, suffering with an acute gangrenous retrocecal appendicitis, duration one week, was admitted to St. Vincent's Hospital and operated January 17, 1923. The third day he developed a left-sided parotitis.

This patient already in a serious state reacted slightly to the parotid involvement. This systemic reaction was represented by an increased temperature rate and more rapid pulse. Locally, there was decided discomfort, with pain, swelling of gland and dryness of mouth. With the application of iodine and ice the enlargement rapidly subsided and had entirely disappeared on the fifth day.

Second type or acute suppurative parotitis. *a* In the first division, classed as circumscribed or lobular parotitis, where abscess formation has taken place, both local and systematic reaction are intensified in comparison with type one. It is next in frequency but relatively rare. The infective process attacks the lobules spreading to the periphery and infiltrates the glandular structure. With

* Read before the Toledo and Lucas County Academy of Medicine, June 1, 1923.

this inflammatory infiltration Stenson's duct remains patent and, when no obstruction exists, pus readily extrudes itself into the oral cavity. Gentle pressure on parotid, associated with bimanual manipulation, practiced often leads to ultimate recovery.

It is necessary in this type to exclude any occlusion of the duct by stone or cicatrices in the buccal mucous membrane. There may be present an inflammatory occlusion of the duct which is relieved temporarily by the passage of a probe, and the procedure should be continued till the obstruction is eliminated. In one case the writer split the orifice of the duct one-quarter inch and removed an impacted stone, which was followed by a free flow of pus. The case recovered without further surgical intervention.

Illustrative Case.—Mrs. M. H., age fifty-five, suffering with duodenal ulcer; infective cholecystitis and lymphangitis with many perigastric and perihaptic adhesions, was operated upon at St. Vincent's Hospital, December 20, 1915. Cholecystectomy and posterior gastro-enterostomy with pyloric exclusion were performed.

Third day developed a right-sided parotitis represented by chill, elevation of temperature and pulse rate, general myalgia. Locally, pain and swelling not diffuse but somewhat circumscribed and involved the anterior and superior portions. With the application of iodine and ice the patient improved but it was noted accidentally that pressure on parotid expressed pus from Stenson's duct. To relieve the pain of distention the patient became adept in the manipulation of the gland. Without further surgical intervention this case entirely recovered.

b In the second division of suppurative parotitis classed as diffuse parotitis there is surgical pathology of grave import.

This type is rare. But few cases or none are allotted in the life work of the surgeon as an individual. Collectively there have been many reported cases. Its inception is ushered in with local and constitutional symptoms as in the other types. Differentiation may be determined as the hours elapse as to its probable severity, by the augmentation of both objective and subjective signs. At no stage of the inflammation is there a diminution in the severity of symptoms; suppuration occurs early, from thirty-six to forty-eight hours; immense swelling of face; dysphagia; meningeal disturbances and nerve irritation associated with repeated chills, rigors, and high temperature and rapid pulse; leucocytosis increased.

If spontaneous evolution does not take place early, *i.e.*, the evacuation of pus through Stenson's duct, the parotideo-masseteric fascia covering the gland becomes involved in the necrotic process and pus infiltrates the surrounding teguments, burrows through the external auriculation, may fuse towards the supraclavicular region, or, following the sheaths of the vessels, involve the mediastinum. Retropharyngeal abscesses have been noted. The mortality rate in this type is about 30 per cent. In cachectic cases this type has a determination towards a gangrenous evolution. The violet skin becomes sphacelous, allowing multiple gas bullae to escape, as well as sanious fluid of infected odor.

Illustrative Cases.—(1) Mrs. H. M., age forty, suffering with infected laceration of cervix, retroversion, visceroptosis, and chronic appendicitis, was operated upon at St. Vincent's Hospital, January 19, 1923. Operation consisted of high amputation of cervix, appendectomy and shortening round ligaments (Baldy's technic).

On third day complained of pain in left ear and side of neck. On fourth day complained of pain in left cheek. On fifth day tumefaction of parotid was noticed; this rapidly increased in size with repeated chills, temperature 103, pulse 100; much phlegm in mouth with dysphagia, beginning disturbance of seventh nerve. Complete suppuration of entire gland had taken place and the surrounding tissues were infiltrated with pus.

The exposure of gland was obtained by a long incision from the zygoma, anterior and close to the tragus, down along the sternocleidomastoid muscle, and further supplemented by a two and one-half inch curvilinear incision extending from the mastoid and joining the original incision. This latter clearly exposed the retromandibular fossa. Immediate improvement was noted.

Culture showed the staphylococcus present.

Discharged from hospital on thirty-third day, healing of parotid incision having taken place. Recovery of muscles noted; slight drooping of corner of mouth and eyelid; no salivary fistula, but some discharge from external ear. Later examination shows entire recovery of nerve, no depression of side of face, scars dimly visible.

This parotidean incision healed readily and with minimum scar. The writer urges its employment where the suppuration has extended into the surrounding tissues and especially to reach the retromandibular fossa. The parotidean incision would simulate the letter Y.

(2) Miss E. R., age forty-five, was operated upon March 13, 1920, at St. Vincent's Hospital for adenocarcinoma of stomach. A Polya operation was done, resection of four-fifths of stomach and enucleation of all involved lymphatic glands. Post-operative parotitis developed on the twelfth day associated with grave systemic disturbances. On the fourth day of its inception, March 29, 1920, the Blair-Lalienthal incision was made, exposing the suppurating gland in its entirety; multiple transverse incisions made; much debris removed; cavity packed with iodoform gauze and incision left open. Examination of pus showed pure culture of staphylococcus.

Healing was rapid; temperature and pulse range approached the normal; no nerve disturbance; depression existed in parotid area; scar hardly visible. Discharged from hospital April 22, 1920, in good condition.

Died one and one-half years later from recurrence of carcinoma.

(3) Mrs. D., age thirty-four, was operated upon February 27, 1919, at St. Vincent's Hospital for an adherent left ovarian cyst with torsion of pedicle and chronic appendicitis.

Second day following right parotitis began and during its progress patient's condition was critical. The systemic reaction was characteristic of a high grade of sepsis with meningeal disturbances; tense and stiff the muscles of the side of face and head with drooping of eyelid, associated with dysphagia, chills, high temperature and rapid, weak pulse were present. White count, 21,400. On sixth day gland was exposed and drained. Pus showed clear culture of staphylococcus aureus.

Discharged from hospital April 13, 1919, with ultimate and complete recovery.

Third Type or Gangrenous Parotitis.—Fortunately this type is rare. In a search of the literature on this subject, all writers report invariably a fatal result. The similarity of the incidence of the infection as in the other types, is noted in this protean of diseases. However, a higher leucocytosis, a greater systemic reaction, a greater local disturbance is also noted in its inception. The compactly arranged lobules of the gland, covered by the unyielding parotideo-masseteric fascia, favors the rapid development of gangrene.

Dependent upon the nature of the infective organisms, phlebitis and thrombosis develop early: ulceration of vessels with fatal hemorrhage may ensue; the surrounding structures become involved in the gangrenous invasion and death results from pyohæmia or sapræmia or septicæmia, intensified and hastened by the richness of the lymphatic and venous circulation.

Illustrative Case.—(4) Mrs. J. B. M., age thirty-six, suffering with an acute gangrenous appendix with perforation and abscess formation, was operated upon May 31, 1922. Her history disclosed she had suffered some past few months with a right parotitis of indefinite origin and of short duration.

Third day after operation elevation of pulse from 90 to 120, temperature from 100 to 103, beginning pain and swelling in right parotid, which increased rapidly in size. Delirium from the inception of parotid involvement with dysphagia. Two days later temperature 105, pulse 140, very delirious. Tumefaction increased to immense size. Parotid was immediately exposed by a long incision extending from zygoma down to the sternocleidomastoid muscles. Complete necrotic disintegration of gland had taken place with most foul odor. Cultures from the debris were negative as to organisms. Despite wide open drainage and the removal of the whole necrotic gland, the axillary temperature rose to 107, pulse fast and weak. Death ensued twelve hours later.

SUMMARY

1. Every post-operative parotitis is a potential lethal factor until it proves itself benign.
2. To await spontaneous evolution of parotitis is jeopardizing life.
3. Differential diagnosis of these types suggests at once the method of relief, medical or surgical.
4. When surgical, operate early, with free incision, and open drainage.
5. The greater the involvement of the face and neck structures, and especially in gangrenous parotitis, the greater the need for more thorough exposure.
6. The Y incision meets all indications. Extending from the zygoma in a curvilinear manner, following the sternocleidomastoid, to the supraclavicular region if necessary. Its posterior limb extending from the mastoid and joining it below the angle of jaw.

THE IMPORTANCE IN SURGERY OF THE THYROID GLAND OF THE CORRECT DIFFERENTIAL DIAGNOSIS OF THYROID DISEASES*

BY WALTER M. BOOTHBY, M.D.

OF ROCHESTER, MINN.

SECTION ON CLINICAL METABOLISM, MAYO CLINIC

DURING the last few years, clinical and laboratory workers have been giving more and more attention to refinements in the diagnosis of the various thyroid diseases. Only recently, the surgeon has become impressed with the importance of a correct differential diagnosis in order to show whether or not operation is indicated, the type of operation advisable, the influence of such careful differentiation on the results of operation, and on the mortality rate.

Plummer's classification of thyroid disease, which has been in use at the Mayo Clinic for several years, is based on structural, functional, etiologic and clinical characteristics which are correlated on fundamental grounds into nine distinct diseases: (1) diffuse colloid goiter; (2) adenomatous goiter without hyperthyroidism; (3) adenomatous goiter with hyperthyroidism; (4) exophthalmic goiter; (5) myxedema; (6) cretinism; (7) myxedema of childhood; (8) thyroiditis; and (9) malignant disease of the thyroid.

I shall confine my discussion to the first four of these conditions, as they are of particular importance to the surgeon, and shall emphasize the reasons why differentiation of the conditions is important in surgery of the thyroid gland.

Diffuse colloid goiter is a symmetric enlargement of the thyroid gland, characterized pathologically by an excess of colloid in the acini, and unassociated with symptoms of hyperthyroidism. Many patients with simple diffuse colloid goiter have increased vascularity or hyperemia of the gland, and not infrequently thrills and bruit. On palpation the gland feels quite similar to that in typical exophthalmic goiter, and therefore, if the enlargement occurs in a nervous unstable person who has symptoms recognized as "effort syndrome" or "disordered action of the heart," a mistaken diagnosis of exophthalmic goiter is readily and unwittingly made. The basal metabolic rate is a great help in distinguishing these cases from exophthalmic goiter, because the rate is not only not persistently elevated in diffuse colloid goiter, but is usually somewhat below normal, while in exophthalmic goiter, with rare exceptions, it is more than 20 per cent. above normal.

Diffuse colloid goiter is much more common in certain regions, and where it is most common, it is usually more accurately diagnosed and possibly, therefore, less often needlessly operated on. In the very early stages of the disease the patients are greatly benefited by the administration of iodine and, later, of thyroid extract or thyroxine. Operation is indicated only if the goiter becomes

* Read before the Philadelphia Academy of Surgery, May 7, 1923.

excessively large and does not respond to medication; such failure of medication indicates that the enlargement may be due to colloid adenomatous tissue, and not to typical diffuse colloid goiter.

Patients with diffuse colloid goiter are safe operative risks; they also get well under medical treatment; therefore, the surgeon, by including the condition in the classification of exophthalmic goiter, will greatly reduce his mortality rate, and similarly the internist will increase the number of patients getting well under medical treatment. At the Mayo Clinic, no patient with diffuse colloid goiter and a normal basal metabolic rate has been operated on during 1922.

Adenomatous goiter without hyperthyroidism is a nodular enlargement of the thyroid gland which does not cause constitutional symptoms, nor alteration in the concentration of thyroxin in the body. This type of goiter, like diffuse colloid goiter, is endemic, and seems also to be due, in the main, to deficiency of iodine. In most cases these nodular masses are surrounded by a definite capsule, and even when without a capsule can often be recognized as true tumors, possibly originating from the embryonic tissue rests known as wolffian bodies; they are, therefore, grossly and developmentally different from the diffuse enlargement of exophthalmic and of diffuse colloid goiter.

Adenomatous masses, as a rule, do not respond completely to thyroid or iodine medication; in fact iodine is particularly dangerous in cases of long standing of adenomatous goiter without hyperthyroidism, because the iodine is likely to stimulate, or rather aid the adenomatous tissue to hyperfunction, and thus to precipitate the constitutional symptoms of hyperthyroidism with its attendant dangers. Kocher and others have repeatedly warned against the dangers of giving iodine excessively and indiscriminately to patients with goiters; in all probability the greater number of patients harmed belonged to this group.

Operation is indicated for adenomatous goiter without hyperthyroidism for cosmetic reasons, for the relief of pressure symptoms, and as a preventive measure against future hyperthyroidism. In order to estimate the probable risk to the patient, accurate distinction must be made between it and adenomatous goiter with hyperthyroidism. For this purpose the basal metabolic rate is of great help, because if it is within normal limits it excludes hyperthyroidism. During 1922 in the Mayo Clinic, thyroidectomy was performed on 663 patients for adenomatous goiter without hyperthyroidism, with only one post-operative death, a mortality rate by case of 0.15 per cent.

Adenomatous goiter with hyperthyroidism is a constitutional disease due to the presence in the thyroid gland of adenomatous tissue which, by maintaining an abnormally high and unregulated concentration of thyroxin in the body, causes an increased basal metabolic rate with the resulting secondary manifestations. Plummer was the first to recognize the condition as a distinct disease.

By studies of the effect of the intravenous injection of thyroxin on the myxedematous patient, Plummer has shown that the level of the metabolism in the thyroidless individual, usually about 40 per cent., is elevated to and maintained at normal, if the normal concentration of approximately 14 mg. of thyroxin is established and maintained in the body. The symptoms produced by the administration of an excess of thyroxin are identical with those produced by hyperfunctioning adenomatous tissue, and, therefore, cases of adenomatous goiter with hyperthyroidism are probably due to an increase in the amount of normal thyroid secretion in the body, above that equivalent to 14 mg. of thyroxin.

From the surgical viewpoint, the fact that the constitutional symptoms are due to the activity of the tumor is very important, because it permits the surgeon to assure the patient, before operation, of almost certain cure, provided the disease has not lasted long enough to produce permanent and irreparable damage of the heart or other organs. The operative risk is, however, much greater than in cases of adenomatous goiter without hyperthyroidism, and may be higher than in cases of exophthalmic goiter. Some of the reasons for this higher mortality seem to be, first, that many of the patients are over fifty years of age, and second, that the location of the adenoma may be such that it will be necessary to dissect in the neighborhood of the recurrent laryngeal nerve, or in the thoracic cavity, with corresponding increase in the severity of the operation and the danger of post-operative complications in the respiratory tract. In the Clinic, during 1922, thyroidectomies were performed on 205 patients with adenomatous goiter with hyperthyroidism, with seven post-operative deaths, a mortality rate by case of 3.41 per cent. Failure sharply and accurately to differentiate adenomatous goiter with hyperthyroidism from that without hyperthyroidism will, of course, result in a very low mortality rate; 868 thyroidectomies for adenomatous goiter, with and without hyperthyroidism, were performed with eight deaths, a mortality rate of 0.93 per cent. However, from a mortality rate so estimated, there is comparatively little to learn, and it is presented here merely to emphasize the importance of correctly differentiating the various thyroid diseases in the compilation of mortality statistics, in order that accurate and sound deductions may be made.

Adenomatous goiter with hyperthyroidism is necessarily more common in regions in which endemic goiter is common. In regions in which goiter is not endemic, it is likely to be overlooked, especially if it happens to be a single small adenoma; under such circumstances the most common mistake is to interpret as primary, the secondary cardiac condition that is caused by the hyperfunctioning adenomatous tissue, the symptoms of which will disappear on removal of the tumor; the more severe cases are on the other hand usually mistaken for exophthalmic goiter.

Exophthalmic goiter is a constitutional disease, apparently due to excessive, probably abnormal, secretion of an enlarged thyroid gland with pathologically diffuse, parenchymatous hypertrophy and hyperplasia. The condition is

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characterized by an increased basal metabolic rate and the resulting secondary manifestations, by a peculiar nervous syndrome, and, usually, by exophthalmos with a tendency to gastro-intestinal crisis of vomiting and diarrhoea. The cause of the altered pathology and disturbed function of the thyroid gland is not known.

I have called attention to the fact that, clinically, it is very important to exclude from this group of cases, cases of diffuse colloid goiter, and also to eliminate cases of adenomatous goiter with hyperthyroidism. Aside from the satisfaction of making a correct differential diagnosis, it is essential to exclude the latter group, because the on-set, prospective treatment, type of operation advisable, and prognosis, as well as the etiology, differ in many respects in the two diseases.

In reply to the question: "If both exophthalmic goiter and adenomatous goiter with hyperthyroidism are due to an excess of thyroid secretion, can there be a differentiation into two diseases?" several hypothetical answers are possible, but the one held by Plummer as the most probable is briefly as follows:

The symptoms of adenomatous goiter with hyperthyroidism can be produced by the administration of an excess of thyroid extract or thyroxin; therefore, adenomatous goiter with hyperthyroidism is regarded as due to the presence in the body of an excess of normal thyroid secretion.

The symptoms of exophthalmic goiter, however, cannot in their entirety be produced by thyroid feeding. The symptoms which are not produced in characteristic form are exophthalmos, the typical gastro-intestinal crisis, the peculiar nervous phenomena, and finally the metabolic status, as a result of which a post-operative reaction may arise which terminates in death within about thirty-six hours. While probably never entirely absent, this post-operative reaction varies from one of negligible intensity to a reaction so severe that death results; the suddenness and unexpectedness of this reaction, and its occurrence in patients who appear in excellent condition, are exceedingly distressing. All of these symptoms which are characteristic of exophthalmic goiter can probably be explained on the assumption that the secretion of the thyroid gland is not only present in excess, but that it is also an abnormal product. Moebius was the first to suggest, in general terms, the possibility of a "pathologic activity of the thyroid gland"; his ideas and those of others, with regard to the mechanism involved, were necessarily indefinite and general; even at the present time, any detailed explanation must be considered tentative. Kendall, however, in his studies of the composition and synthesis of thyroxin has isolated many substances which have a graphic chemical formula, quite similar to that of thyroxin. He has found it particularly difficult to introduce iodine in the proper manner into what he designates as the thyroxin nucleus. If it is a difficult procedure in the test tube, conditions can be conceived which would render it difficult of synthesis by the thyroid gland, and one such condition might be insufficient concentration or availability of iodine. During the last year Plummer has shown, by a very extensive series of experiments,

that many of the most outstanding and characteristic symptoms of exophthalmic goiter disappear rapidly and with a high degree of regularity following the administration of iodine. Plummer's observations led him to postulate that, following the administration of iodine, there would be a decrease in frequency and intensity of the post-operative hyperthyroid crisis, and, as just reported by Plummer at the meeting of the American physicians, the correctness of the theory has received substantial confirmation by the almost complete disappearance of this most dangerous reaction following operations on patients with exophthalmic goiter, who had received iodine pre-operatively.

As has recently been emphasized by Richardson, it is important, in considering statistics on the mortality rate in thyroid surgery, to know whether or not they are calculated separately for patients who do and do not have hyperthyroidism, and whether or not they are calculated on the basis of the number of cases or on the number of operations. However, in a disease like exophthalmic goiter in which in many instances multiple operations are performed, extending over a period of several months, it is impossible to determine with absolute accuracy the exact mortality for a calendar year on the basis of the rate for each patient.

In making the report on the mortality rate following operation on the thyroid in 1922, the Division of Surgery of the Mayo Clinic adopted Plummer's classification. Regardless of the immediate cause of death, or the length of time after operation on the thyroid, all deaths occurring in Rochester were charged against the operation and included in the mortality calculation. C. H. Mayo and Pemberton report one thousand nine hundred eighty-three operations on the thyroid gland in 1922, with nineteen deaths, a mortality rate of 0.96 per cent. The mortality rate in cases of adenomatous goiter without hyperthyroidism for 663 patients is 0.15 per cent, and in cases of adenomatous goiter with hyperthyroidism for 205 patients, is 3.41 per cent. Eleven patients with exophthalmic goiter died following operations on the thyroid gland. In all, there were 1093 operations for exophthalmic goiter, a mortality, based on the number of operations, of practically 1 per cent. During the year, 633 patients with exophthalmic goiter were accepted as operative risks; on this basis the mortality rate by case from eleven deaths is 1.74 per cent. The mortality following thyroidectomy in exophthalmic goiter is 0.96 per cent.

PRIMARY SARCOMA OF THE ŒSOPHAGUS*

By CURTIS E. SMITH, M.D.

AND

G. Y. RUSK, M.D.

OF SAN FRANCISCO, CAL.

A REVIEW of the literature shows that primary sarcoma of the œsophagus is a rare affection. Most of the cases have been regarded as pathological curiosities. Sarcoma of the pharynx, on the other hand, is not so uncommon and in various reports some of these cases have been confused with sarcoma of the œsophagus. The apparent rarity of sarcoma may be due in part to a lack of careful histological study of œsophageal tumors. Clinically there may be no difference in symptomatology between sarcoma and carcinoma of the œsophagus, and the annular, ulcerating types of sarcoma can only be differentiated pathologically by microscopic examination.

To the previously reported cases we are able to add another, that of a polypoid, spindle-cell fibrosarcoma of the lower end of the œsophagus.

The patient, a Scandanavian farmer, thirty years of age, was referred to Dr. Harold Brunn by Doctor Gross of Eureka because of difficulty in swallowing and vomiting.

Past History is essentially negative. There was an injury to the right flank four years ago followed by continued bleeding from the right kidney.

* From the Surgical Service of Dr. Harold Brunn and the Department of Pathology, University of California Medical School and Hospitals.



FIG. 1. Showing position of polypoid sarcoma in the œsophagus.

This was relieved later by some operative procedure on the kidney. This trauma had no relation to the present condition.

Present Illness.—Eleven months before death the patient began to have difficulty in swallowing with regurgitation of solid food. When the bolus of food was swallowed it seemed to meet obstruction in the lower part of the



FIG. 2.—Tumor reflected to show areas of ulceration in mucous membrane of the œsophagus.

œsophagus. He has never had pain. There has been no hæmatemesis, but at times he vomited pieces of meat-like material suggestive of necrotic tumor tissue. The symptoms grew progressively worse. Vomiting was spontaneous without direct relation to eating. He lost thirty pounds in weight. He was first seen at the hospital six months after the first symptoms appeared.

Physical Examination at this time was essentially negative. The patient was very tall and thin. The Wassermann, urine and blood examinations were negative except for a slight leucocytosis. Fluoroscopic examination by Dr. Lloyd Bryan showed an obstruction in the lower third of the œsophagus with some dilatation above it. The bismuth grad-

ually passed along almost surrounding the mass which nearly filled the œsophagus. The œsophageal wall had a definite smooth outline except at one place where the bismuth did not penetrate and which might be considered to be the origin of the tumor. The appearance was that of a polypoid mass and not a carcinoma.

While the patient was in the hospital he vomited several pieces of the tumor; some as large as the end of the thumb with a necrotic surface. These were sent to Doctor Rusk for pathological examination. Most of the tissue was necrotic, but in a few areas there was tissue composed of small cells of connective tissue type, with relatively broad nuclei and a very finely fibrillar intercellular substance giving the appearance of a myxomatous tissue. Occasional mitotic division of cells was observed. Relatively abundant thin-walled vessels were found running through the growth. Diagnosis: sarcoma, possibly myxosarcoma.

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Following the expulsion of the tumor masses the patient was able to swallow solid food and his weight increased. The location of the growth seemed favorable for an extra-pleural operation, but after considering the type of growth and the high mortality from these operations it was decided to try radium treatment.

May 6.—A gastrotomy after the method of Witzel was performed under local anesthesia. The reason for gastrotomy at this time was to allow intensive radium treatment and to guard against any difficulty in swallowing that might be encountered due to oedema following these treatments.

May 19.—Oesophagoscopy by Dr. Wallace B. Smith. The upper pole of the tumor measured 35 cm. from the incisor teeth. A section of the tumor was removed for further histological study and seven radium tubes were inserted into the tumor. Microscopic examination of this tissue showed the same type of growth as described above. The patient went home the latter part of May and shortly afterwards vomited large masses of the tumor tissue. He returned July 10 for another radium treatment and at this time was able to swallow solid food without difficulty and looked very much improved. A third radium treatment was given August 18, but this was not followed by expulsion of necrotic tumor masses and he again began to have increasing dysphagia. Operation was now advised but the patient refused to consider this.



FIG. 3.—Showing three necrotic masses of right cerebral hemisphere.

He returned to the hospital October 5, 1922, reporting that he had had two convulsive seizures while at home. He had again become cachectic and apathetic. In the hospital he was delirious at night. There was no fever.

Fluoroscopic examination now showed considerable enlargement of the tumor mass and the condition was considered inoperable. A few days before death he was walking about. A deep X-ray treatment was given, during which he had a convulsive seizure which began with twitching of the face and then extended over the entire body. Three days later, October 15, he suddenly died.

Abstract of Autopsy Protocol.—Healed gastrotomy. Adhesions about the

right kidney which is much smaller than the left. Fine fibrous adhesions between œsophagus and lower lobe of the left lung. Mediastinal nodes negative. A few patches of bronchopneumonia in the lower lobes of both lungs. Other viscera negative.

Œsophagus: Between the bifurcation of the trachea and the diaphragm the œsophagus bulges and palpation reveals a large tumor mass in this region. Incision made along the left side shows considerable tension over the tumor. There is dilatation with thickening of the walls above the tumor. The polypoid, kidney-shaped tumor measures $12.5 \times 4.5 \times 2.5$ cm. It is attached to the posterior wall by a fibrous pedicle 6×1 cm. At the base of this pedicle the wall is thick, firm and fibrous and a nodule 1.5 cm. in diameter projects through the posterior wall. The lower pole of the tumor is situated 2 cm. above the cardia of the stomach. The surface is wrinkled and nodular with necrotic material on the surface. There is sloughing and necrosis in the centre so that the tumor has been almost completely bisected longitudinally through the upper three-fourths. The portion which is not necrotic is tough and elastic and on section shows a whitish, homogeneous structure. On the right lateral wall of the œsophagus opposite the upper half of the tumor there is an area of ulceration in the mucosa 6×2 cm. Just beneath the lower pole there is a similar ulceration 2 cm. in diameter. There are no metastases.

Brain.—There is thrombosis in the anterior portion of the superior sagittal sinus. When the dura is incised a large amount of thick, foul-smelling pus is found covering the entire right hemisphere. Abscesses are found in the right temporal lobe and in both frontal lobes. The right frontal lobe bulges against the falx with encroachment on the left frontal lobe. Cultures from these abscesses show pneumococci and Gram-negative bacilli.

Anatomical Diagnoses.—Primary polypoid sarcoma of the œsophagus. Disseminated foci of pneumonia (possibly embolic) in lower lobes of both lungs. Multiple brain abscesses with purulent meningitis. Thrombosis of the superior sagittal sinus. Healed gastrostomy.

Microscopic Examination.—Sections from a number of points in the tumor show it to be rather uniform in structure, made up of a tissue rich in cells that course in various directions. The cells are of spindle shape, fairly uniform in size, and have a fine intercellular framework of connective tissue. The nuclei stain deeply except in areas near the surface where they are swollen and vesicular. There are many cells showing mitotic division.

A section from the nodule at the base of the pedicle of the tumor where the growth has extended through the wall of the œsophagus shows the same type of cell as found in the main tumor.

Throughout the tissue there are many thin-walled blood-vessels and in some areas there is extravasation of red blood-cells between the tumor cells.

Some sections show extensive necrosis on the surface. Below the necrotic areas there is marked œdema of the tissue with swollen and fragmented cells. There is marked infiltration of polymorphonuclear leucocytes and plasma cells. Where the surface is not necrotic it is found covered with atrophic squamous epithelium. In no area does one find proliferation of these epithelial cells.

The brain abscesses and meningitis as terminal affections in this case are interesting and unusual. The infection probably originated in the ulcerated areas in the œsophagus, passing through the lungs without evidence of localization and setting up foci of infection in the brain. This is considered as possibly occurring about the time of and precipitating his first convulsions. A re-infection in the same manner was probably responsible for the terminal conditions that caused his death; namely, the foci of pneumonia and meningitis. Cerebral infec-

tion, as is well known, often happens in cases of bronchiectasis or lung abscess, and we believe the process here is somewhat analogous.

The lungs fail to show any evidence of old inflammatory reaction except fibrous adhesions between the lower lobes and the oesophagus in the region of the tumor. The course of the disease was afebrile and there was nothing clinically to suggest the brain abscesses and meningitis except the convulsions and transient delirium. The spleen, kidneys, heart and other viscera showed no signs of a general septicæmia either grossly or on microscopic examination so we must conclude that the infection was swept into the blood stream and localized in the brain without producing a general infection.

Table I shows the reported cases of primary sarcoma of the oesophagus.

In discussing Borrmann's case at the German Pathological Congress, Lubarsch mentioned a polypoid fibrosarcoma which he had found in the oesophagus of a horse. Orth referred to a case in the Berlin museum similar to that of Borrmann. M. B. Schmidt mentioned a case of rhabdomyosarcoma which came to autopsy in his clinic at Zurich.

In addition to the cases given in Table I the following cases have been discussed by various authors:

Oppenheimer reported a case as primary sarcoma of the oesophagus without microscopic studies. From the description this was apparently an aneurism of an oesophageal artery filled with a laminated clot.

In the cases of Körner, Albrecht and Paget the tumor arose in the pharynx.

In the cases reported by Rotschy, Perez, Kundrat and Schlagenhauser the tumor arose in the mediastinum with secondary involvement of the oesophagus.

The case reported by Huisman was probably a primary sarcoma of the femur with secondary involvement of the oesophagus.

Kraus says that the case reported by Butlin was primary sarcoma of the tongue.

Von Hanseman reported a case of carcinoma-sarcomatodes of the oesophagus, but original report was not available.

An analysis of Table I shows the following:

Including our case, 35 cases of primary sarcoma of the oesophagus have been reported. The average age of these patients is 53.6 years. The condition is much more common in men. Where sex is given there are 26 men and 7 women.

Practically every case showed dysphagia due to stenosis or obstruction by the tumor. Pain was present in many cases, its location varying according to the site of the tumor.

In 24 cases the tumor occurred in the lower half of the oesophagus. It was found in the upper half in 8, in the middle in 1, and in 2 cases the growth involved both middle and lower part.

In 14 cases the growth was polypoid, in 12 nodular and diffuse, in 9 annular. Many in the last two groups showed ulceration.

TABLE I.
Primary Sarcoma of the Esophagus.

Author	Age and sex	Symptoms	Site of tumor	Morphology	Origin	Type	Metastases
1. Chapman	45 M	Dysphagia. Pain	Upper half	Nodular. Diffuse.	Submucosa	Spindle cell. Some round cells	Nodes about esophagus
2. Dubreuil . . .	49 M	Dysphagia.	Upper half	Nodular. Ulcerated	?	Sarcoma	Nodes behind right clavicle.
3. Targett	70 M	Dysphagia. Pain	Lower half	Polypoid	Submucosa	Small round spindle cells	None.
4. Stephan	4 M	Dysphagia. Dyspnea	Lower half	Polypoid	Submucosa	Lymphosarcoma	None.
5. Shaw	38 F	Dysphagia	Upper half	Annular. Ulcerated. Diffuse.	?	Round and oval cells	Adjacent nodes, lungs and kidneys.
6. Rolleston . . .	54 M	Dysphagia. Tumor in left hypochondrium	Lower half	Annular. Ulcerated. Stricture.	Submucosa	Round cell	Nodes in mediastinum and abdomen; to ribs, ilium and skull.
7. Wolfensberger .	75 M	Dysphagia. Cough	Lower half	Polypoid	Muscularis	Rhabdomyosarcoma	Nodes along stomach.
8. Von Nothhaft..	84 M	Sl. dysphagia	Lower half	Hard nodule, size of walnut	Submucosa	Small spindle cell	None.
9. Ogle	50 M	Dysphagia	Middle	Polypoid	Submucosa	Large spindle cell	None.
10. James	?	Dysphagia	Lower half	Annular. Soft	?	Alveoli of spindle cells	Tongue and nodes of neck.
11. Livingood . . .	55 M	Dysphagia. Sternal pain	Lower half	Nodular	Submucosa	Spindle cell	None

PRIMARY SARCOMA OF THE OESOPHAGUS

12. Gastpar	54 M	Dysphagia. Pain	Lower half	Annular. Nodular	Diffuse.	Submucosa	Large round and spindle cells	None.
13. Starck	64 F	Dysphagia. Sternal pain	Lower half	Diffuse.	Ulcerated	Mucosa (?)	Large round cell. Some giant cells	Brain, lungs, pleura, ribs, liver, kidneys and abd. nodes.
14. Starck	41 M	Dysphagia. Pain. Hem- atemesis	Lower half	Annular.	Diffuse	Mucosa (?)	Large round cell	Liver.
15. Krutner	42 M	?	Lower half	Polypoid		Submucosa	Spindle and giant cells	None mentioned.
16. Chila	55 M	Dysphagia. Hemorrhage. Swelling neck	Upper half	Annular.	Diffuse	Submucosa	Small round cell	? Cervical nodes.
17. Glinski	68 M	Dysphagia. Abd. pain	Lower half	Polypoid		Muscularis	Rhabdomyosarcoma	None.
18. Von Eicken	39 M	Dysphagia. Pain. Fever	Lower half	Diffuse.	Ulcerated	Submucosa	Spindle and giant cell	None.
19. Howard	51 M	Dysphagia. Vomiting	Lower half	Annular.	Ulcerated	Muscularis	Myosarcoma	Adjacent nodes. Sto- mach.
20. Frattin	? ?	Dysphagia	Upper half in diver- ticulum	Nodular.	Diffuse	Submucosa	Lymphangioendothelioma	None.
21. Lange	64 F	Dysphagia	Lower half	Polypoid		?	Spindle and large round cell	None.
22. Wegener	32 M	Dysphagia. Chest pain	Middle and lower half	Annular. Polypoid	Diffuse.	Submucosa	Large round cell	Right lung. Mediasti- nal nodes.
23. Baer	69 M	Dysphagia. Pain in neck	Upper half	Nodule size of wal- nut	size of wal- nut	?	Melanotic spindle cell	None.
24. Frangenheim	63 F	Dysphagia. Cachexia	Lower half	Polypoid size of hen's egg	size of hen's egg	Submucosa	Small and large spindle cells	Oesophageal and gastric nodes.
25. Johat	62 M	?	Lower half	Nodular.	Diffuse	?	Melanosarcoma	Liver and peritoneum.

TABLE I. (Continued).
Primary Sarcoma of the Esophagus.

Author	Age and Sex	Symptoms	Site of tumor	Morphology	Origin	Type	Metastases
26. Donath.....	58 M	?	Lower half	Diffuse, Ulcerated	Submucosa	Small spindle cell	Mediastinal and gastric nodes.
27. Donath.....	52 M	Pneumophagus, Pneumonia	Lower half	Polypoid	Submucosa	Alveolar endothelial sarcoma	Adjacent nodes.
28. Von Hacker...	70 M	Dysphagia, Abdominal pain, Hemoptysis	Lower half	Polypoid	Muscularis	Leiomyosarcoma	None.
29. Von Hacker...	46 F	Dysphagia, Pain	Upper half	Submucosal, polypoid, Ulcerated	Mucosa	Round and spindle cell	Cervical nodes and liver.
30. Bormann...	48 M	Dysphagia	Middle and lower half	2 polypoid tumors	Muscularis	Spindle and giant cells, Probably rhabdomyosarcoma	None.
31. Herxheimer...	67 M	Dysphagia, Chest pain	Lower half	Annular, Ulcerated	Submucosa	Carcinoma-sarcomatodes	None.
32. Rieke.....	46 M	Dysphagia, Chest pain, Cough	Upper half	Nodular, Ulcerated	Submucosa	Large spindle cell	Mediastinal nodes.
33. Bertholet.....	63 F	Ascites, Jaundice, Emaciation	Lower half	Nodular, Ulcerated	Submucosa	Small round and oval cells	Mediastinal and mesenteric nodes. Liver.
34. Hofmann.....	61 M	Dysphagia, Pain	Lower half	Polypoid	Submucosa	Large spindle cell	None.
35. Smith and Rusk	30 M	Dysphagia, Vomiting, Convulsions	Lower half	Polypoid	Submucosa	Small spindle cell fibrosarcoma	None

It seems probable in all cases except the myosarcomata that the growth originated in the submucosa.

Classification according to type of cell shows, 11 spindle cell, 7 mixed spindle and round, 5 round cell, 5 myosarcomata, 2 melanosarcomata, 1 lymphosarcoma, 1 lymphoangioendothelioma, 1 endothelial sarcoma, 1 carcinoma-sarcomatodes, and 1 where type is not given.

Sarcoma of the oesophagus apparently grows more rapidly than carcinoma, but metastases do not seem to occur as frequently as one usually finds in sarcoma elsewhere in the body. In 17 of the above cases no metastases were found. In most of the others only the adjacent nodes were involved, in some, however, extensive metastasis occurred.

In the cases of Lange, Reutter and Frangenheim carcinoma of the oesophagus occurred as separate and distinct tumors coincident with sarcoma. In the case of Herxheimer the tumor was estimated as two-thirds spindle-cell sarcoma and one-third epidermoid cancer, and was called carcinoma-sarcomatodes.

In the cases of Shaw, Rolleston, Livingood, Reutter, Wegener, Baur and the second case of Starck the tumor had perforated the oesophagus with sinuses to trachea, bronchi or lungs with gangrene of the lungs in some cases.

In many cases gastrostomy was necessary, due to stenosis or obstruction in the oesophagus caused by the new growth. In only one instance, the second case of von Hacker, was resection of the oesophagus performed. The growth recurred in adjacent tissue in the cervical region and the patient died three months later of bronchopneumonia.

It seems possible that operation might affect a cure if the patient is seen early, especially in the case of the more slowly growing, polypoid fibrosarcomata like our own case.

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TREATMENT OF HOUR GLASS STOMACH BY DOUBLE GASTRO-ENTEROSTOMY*

BY CHARLES L. GIBSON, M.D.

OF NEW YORK, N. Y.

SURGEON TO THE NEW YORK HOSPITAL

THE object of this paper is to call attention to the value of a procedure which I think should be more often employed. Devised theoretically by Von Hacker and Weir and Foote,† it seems to be performed infrequently and is mentioned with apparent reluctance by the writers on hour-glass stomach.

While I can cite only two cases, the results, immediate and remote, gave the maximum satisfaction to patients and operator.

CASE I.—(Previously reported by Webb, *ANNALS OF SURGERY*, October, 1917.) M. D., forty-two. Housewife. Admitted February 5, 1917, on account of epigastric pain, vomiting and loss of weight. In 1915, weighed one hundred twenty-one pounds. Now weighs about eighty pounds.

Present Illness.—Began two and one-half years before admission with epigastric pain accompanied by gaseous eructations, occurring about three hours after the noon-day meal and continuing until about eleven P.M. Symptoms gradually increased in severity. Pain relieved by vomiting and by taking sodium bicarbonate until about one year before admission, when these measures ceased to give relief. No hæmatemesis or melena. Patient has recently noticed splashing in stomach and peristaltic movements in upper abdomen.

Physical Examination.—There is a bulging tympanitic area in upper half of abdomen corresponding to the position of a dilated stomach. Here peristaltic movements can be seen travelling from left to right and ending under right costal border. Clapotage present. There is a palpable movable mass about the size of a lemon just above and to the right of umbilicus. Wassermann negative.

Operation.—There is a huge stomach, the pyloric pouch three times the size of the cardiac pouch. The constriction between the two pouches is due to cicatrization of a large ulcer which forms a tumor nearly the size of a hand. Pylorus is obstructed by a similar large callous, apparently cicatrized, ulcer. A small node lying on the pylorus excised (microscopical report normal). Double



FIG. 1. Roentgenogram of stomach before operation immediately after ingestion of lemon juice showing great dilatation of pyloric pouch. Position of phot graph is reversed.

* Read before the American Surgical Association, May 31, 1923.

† Medical News, April, 1896

posterior gastro-enterostomy is done, one in the cardiac pouch without clamps, using five rows of sutures, three posteriorly and two anteriorly, using silk for the first and last and fine chromic gut for the other three. The same loop of intestine is used five inches away for a second gastro-enterostomy in the middle of the pyloric pouch.

Subsequent Course.—Recovery uneventful. Sixth day taking soft-solid diet; tenth day sat up in a chair. Discharged March 5, 1917, free from symptoms.

Follow-up, May 7, 1917. Free from symptoms. Has gained thirty-two pounds. Barium series shows stomach empties rapidly, being nearly empty at the end of one hour and practically free from barium at the end of five hours. Both gastro-enterostomy openings are working well. (See Figs. 1-5.)

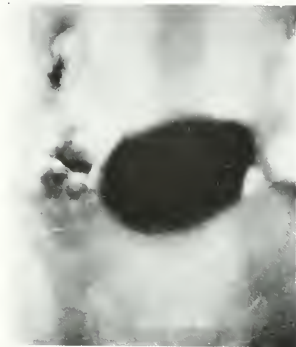


FIG. 2. —Röntgengram of stomach before operation, taken twenty-four hours after ingestion of bismuth, showing retention in pyloric pouch.

Subsequent Notes.—January 30, 1919. Gained enormously in weight. May 1, 1922. Feels O. K. June 15, 1923. Recently mild gastric upset which patient attributes to disturbance of menopause. Weight same.

CASE II.—M. L. Female. Age, fifty-four. *Present Illness.*—Gastric manifestations since the age of eighteen, at which time attacks of pain with distention. These attacks come on three or four hours after meals, and patient has been in the habit of reducing pain by inducing vomiting.

Physical Examination.—Fairly well nourished. Abdomen shows distinct visible peristalsis over its lower part. Wassermann negative. Hemoglobin 88 per cent.

Fluoroscopic Examination.—(By Dr. A. L. Holland.) Large hour-glass stomach, cardiac pouch a little the larger. The upper pouch empties fairly quickly. The pyloric pouch shows a marked retention at the end of thirty hours. There is also a pyloric ulcer with marked obstruction (Fig. 6).

Operation.—(April 26, 1922.) Stomach very large and divided into two pouches. Opening between the two is about the calibre of small intestine. The pyloric pouch is drawn out into the duodenum, both being distinctly smaller calibre, apparently from distortion, as there is no constriction. There is also a Harris band which is separated and some adhesions of the duodenum to the liver. The cardiac pouch is altered; structure seems to be for the most part thick, somewhat indurated, and of whitish appearance. Two gastro-enterostomies are done in the same loop of intestine. Openings are made about two inches and seven inches from the fossa of Treitz as in Case I. Time one hour and twenty minutes.

Convalescence.—Most uneventful. Highest temperature 100°. Never vomited. Discharged May 17th, eating quite substantial diet. Entirely free from any gastric disturbance.

Follow-up, September 27, 1922. In excellent health and reports herself free from any gastric symptoms ever since operation. Gained 25 pounds.

June 14, 1923. "Have been well all winter and able to eat as I never have before."

It is hard to understand why so simple and logical an operation as double gastro-enterostomy is so seldom employed. It seems particularly called for

when, as so often happens, an additional juxta pyloric ulceration causes an actual or potential obstruction. The possibility of overlooking this pyloric stenosis should render us very cautious in confining ourselves to some of the plastic operations (Fig. 7, types I, II, and III); or the anastomosis of the pouches with each other (Fig. 7, types IV, and V). If we do not perform any plastic operations or some form of gastro-enterostomy, there remains then some type of resection (Fig. 7, types VI and IX). In general it may be stated that resection in the hour-glass stomach is to be avoided if the condition can be adequately dealt with otherwise, for the following reasons:

1. The hour-glass stomach is the end result of a long-standing, particularly severe gastric ulceration and most of the patients are greatly debilitated and poor risks.

2. Any form of resection has a definite risk of being followed by any of the varieties of pneumonia.

3. Gastro-enterostomy may very often be performed with great ease under local anesthesia, particularly if the abdominal wall is thin and lax and the stomach is large, or ptosed, as it generally is in emaciated patients.

4. Other operations of less severity give good results.

I have never seen any unfavorable reports following the performance of double gastro-enterostomy. It is possible that to many operators the term "double gastro-enterostomy" means some much more complex procedure than the one used by me (Fig. 7, type VIII), namely typical, no-loop, posterior anastomosis in the same loop of jejunum, the second opening being made wherever the second pouch can be conveniently drawn through a separate opening in the transverse mesocolon, three inches to six inches from the first.

To some the procedure may seem illogical, that the outflow from the first gastro-enterostomy may enter the stomach through the second opening. Admitting for the sake of argument that such a reflux takes place, does it do any harm? Certainly the uneventful convalescence of the cases reported with their splendid after results controvert any theoretical objection. Moreover, if there is any validity to the belief that an alkaline dilution of the acid gastric contents favorably influences or prevents ulceration, the lower pouch and pyloric outlet cannot but be benefited by the intestinal reflux.

In the United States there seems to be a tendency to employ more and more the sleeve (meso-gastric) resection. The principal advantage claimed



FIG. 3.—Röntgen gram of stomach three months after operation, showing hour-glass contracture and bismuth in both pouches. Position in photograph is reversed.

is the removal of a cancer which may simulate the typical hour-glass deformity, or as a prophylaxis of its development. It seems to me that the possible cure of such a cancer must be doubtful. The margin of the resected area is not usually sufficiently wide, and the area of lymphatic drainage toward the pyloric end persists. Some operators have abandoned sleeve resection because an artificial hour-glass has resulted from the narrowing of the anastomosis.

The indications for resection are lessened if we remember that cicatrization represents the healing of an ulceration. The process itself is usually extinct and only its mechanical aftermath has to be considered.

If the lower pouch is very small and particularly if the hour-glass constriction is very tight, a single gastro-enterostomy in the upper pouch may



FIG. 4.—Röntgenogram of stomach three months after operation, taken one hour after ingestion of bismuth, showing both gastro-enterostomy openings working well. Position in photograph is reversed.



FIG. 5.—Röntgenogram of stomach three months after operation, taken five hours after ingestion of bismuth, showing stomach practically empty. Position in photograph is reversed.

suffice in the absence of a pronounced pyloric stenosis (Fig. 7, type VII). In such a condition any form of gastro-enterostomy, posterior, anterior, or anterior retro-colic in the lower pouch might be difficult or functionally imperfect. In such a case, posterior gastro-enterostomy in the large upper pouch may be expected to work well. For instance, one of my patients had a large visible and palpable tumor of the pyloric end of the stomach. Operation showed a large, irregular mass, presenting every appearance of a carcinoma, causing hour-glass deformity with an extremely small second pouch. A posterior gastro-enterostomy in the upper pouch resulted in a good convalescence and subsequent disappearance of the mass.

In conditions such as described, if absolute necessity existed for dealing with a small second pouch, a pylorectomy would probably be best performed. I should feel, however, in poor risks that the operation might be done in two stages, placing the gastro-enterostomy so as to allow eventually of resection.

T. T. Thomas, *British Journal of Surgery*, vol. ix, has made one of the

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most interesting and valuable contributions to the treatment of hour-glass stomach. Some of his observations markedly confirm the complexity of the condition and give valuable hints. In his fifty cases the following procedures were used:

1. Gastroplasty, 7.
2. Gastro-gastrostomy, 15.
3. Posterior gastro-enterostomy in proximal pouch, 14.



FIG. 6.—Print of X-ray plate of hour-glass stomach before operation. Case 11.

4. Double posterior gastro-enterostomy, 2.
5. Retrocolic anterior gastro-enterostomy, 3.
6. Anterior gastro-enterostomy, 3.
7. Gastro-duodenostomy in proximal pouch, 1.
8. Retrocolic anterior gastro-enterostomy in proximal and posterior gastro-enterostomy in distal, 1.
9. Partial gastrectomy, 2.

The mortality is 14 per cent. The end results by any method were good, showing wise judgment in applying the method best suited to any given condition. It is interesting to note that a resection was performed only twice; still more so, the success attending the plastic operations and anastomoses. Personally, I have had rather a prejudice against these latter operations.

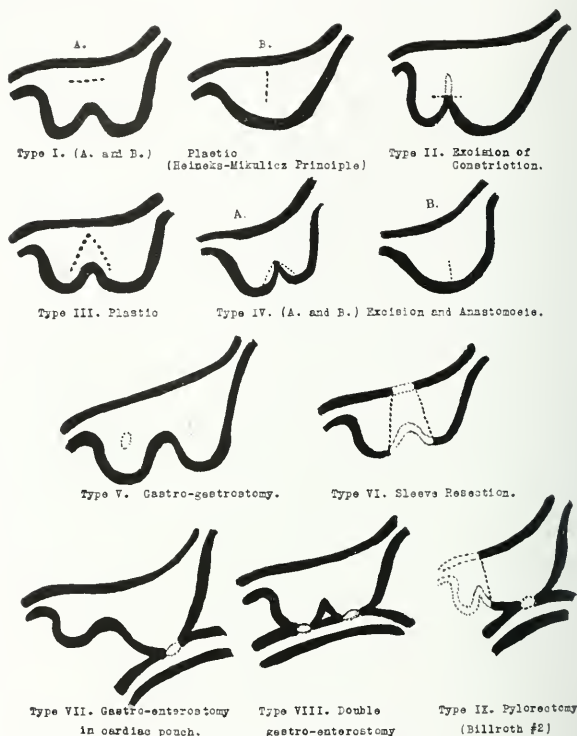


FIG. 7.—Types of operation for hour-glass stomach. These diagrams have been kindly furnished by Dr. Clay Ray Murray, Deputy Assistant Surgeon, New York Hospital.

having had some poor results while other forms of treatment have been successful.

Thomas says, "There is no condition in surgery that may call for so great a variety of procedures to deal with the degrees and complications met with; and although the radiographic evidence affords valuable help, it is impossible in any given case to have the slightest idea beforehand what surgical manoeuvre will be resorted to."

The accuracy of the above statement was illustrated in a case of trifid

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stomach (Fig. 8) occurring early in my experience. The reproduced X-ray picture was outlined by the röntgenologist only after the post-mortem had demonstrated the complexity of the condition.

In conclusion I would call attention to the hint furnished by the size of



FIG. 8.—Print of X-ray plate of trifid hour-glass stenosis.

the lower pouch, as regards the presence of a second obstruction at the pylorus, and it is in these cases where the stomach is divided into pouches of different sizes, or the lower pouch is distinctly large, that the operation of double posterior gastro-enterostomy is particularly indicated.

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REPORT OF A CASE TREATED BY BILE DRAINAGE

By ABRAHAM O. WILENSKY, M.D.

OF NEW YORK, N. Y.

IN previous communications the relationship of the cholesterol metabolism to cholelithiasis and disease of the biliary tract was exhaustively considered. In several of these reports reference was made to a complex of symptoms, referable to the right hypochondrium, which were observed to be associated with an hypercholesterolemia in the absence of any demonstrable stone formation or obstruction in the terminal or other part of the duct system, and in the absence of any complicating condition, such as atherosclerosis, nephritis or glycosuria with a hypercholesterolemia frequently coexists. A case of this kind is reported herewith, in which the condition was recognized before operation, in which the diagnosis was substantiated during an exploratory laparotomy, in which surgical therapy was undertaken with the distinct object of curing, or, at least, relieving the disturbance of metabolism leading to the hypercholesterolemia, and in which a symptomatic cure followed.

The remarks, which follow, have reference exclusively to conditions of pure hypercholesterolemia, in which the complicating factors—obstruction, nephritis, atherosclerosis, diabetes, etc.—play no part unless otherwise indicated in the text.

CASE REPORT

J. B., six years before the patient's first admission to Mt. Sinai Hospital, she had been treated for trigeminal neuralgia. Pain had been present for two years. There were no gastric, or, in fact, any abdominal symptoms of any kind at this time. A symptomatic recovery was made. There is no knowledge concerning the condition of the cholesterol metabolism of the patient at this time.

The patient was first admitted to the hospital (1919-33-1) in December, 1918, for the cure of an umbilical hernia which had given annoying symptoms since the birth of a child two years previously. There were no symptoms at this time which could be definitely referred to the stomach, liver or bile passages. The operation, a Mayo hernioplasty, was followed by uneventful healing of the wound; the convalescence, however, was disturbed by a phlebitis in the left leg. No blood examinations were made at this time. The second admission (1919-61-186) of this patient was in October, 1919. At which time her chief complaint was gastric distress: "heaviness" in epigastrium, duration, 10 months.

Previous history, born in Russia, age fifty-seven years, housewife, married. Has had eleven children of whom four are living and in good health; the cause of death in the others is not known. Menopause, four years ago. Has headaches at times. No cough or dyspnea on exertion. The bowels are constipated. Usually she has a poor appetite. Some nocturia.

Present illness. The present symptoms began ten months ago directly following the operation for the hernia. There is a continuous heavy feeling in the epigastrium which becomes aggravated after the taking of food. There is no

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vomiting of food or other material, or eructations of gas. The pain begins in the epigastrium and radiates to both costal arches. Anorexia is still present and the bowels are constipated. At no time has there been any jaundice. The stools have apparently been normal as far as the patient can tell.

Physical examination. The general condition of the patient is good. There are no evidences of any acute illness. The head is well formed and shows no abnormalities. The ears and mastoids are negative. The eyes show no external abnormalities; vision is good with glasses; the pupils are equal and regular; the pupils react to light and accommodation. The conjunctivæ are not icteric. The oral and nasal cavities show no abnormalities. The teeth are in good condition. The tonsils are not enlarged and appear normal. There is no enlargement of the cervical lymph glands. The thyroid is not enlarged. The chest is of normal shape. The lungs are clear throughout and no abnormalities are distinguishable. The heart is not enlarged to percussion. The apex beat is not seen or felt. The action of the heart is regular and of satisfactory quality. There is a soft blowing systolic murmur at the apex transmitted to the axilla. The pulse is of good quality and tension.

The abdomen is pendulous and soft. No masses or tender points are made out. In the region of the navel there is the scar of the hernioplasty which is well healed and in which there is no recurrence of the hernia. The liver, spleen and kidneys are not palpable. The vaginal examination showed the uterus enlarged to the size of a three months pregnancy, the substance of it being hard and nodular. The rectal examination was negative. The extremities are normal with the exception of marked varicosities of the lower legs. The reflexes are present and equal on both sides. Systolic blood-pressure was 110 mg. Hg; diastolic, 85. Urine negative.

The nature of the underlying disturbance was suspected immediately. A number of questions arose. In December, 1918, when the patient was operated upon for the umbilical hernia, there were no symptoms which could in any way be referred to the liver or the cholesterol metabolism. However, symptoms, which are distinctly referable to the liver and the cholesterol metabolism, began within so short a time after the operation as to make one believe that some factor in the operation had acted as an etiological cause either to call forth these symptoms as something entirely new, or to excite into activity a dormant condition.

The etiological factor was most likely the anesthesia. Anæsthetic drugs, ether less markedly than chloroform, are known to cause destructive changes in the liver cells. These changes occur in a small proportion of the cases and in widely different degrees. Even without anatomical change, the anæsthetic drug undoubtedly has an inhibitory effect on the functional activity of the liver cell leading to an interference with the normal capacity of the liver in storing, handling and excreting cholesterol bodies; and the natural consequence of such disability is an unusual retention of cholesterol in the blood stream.

There is evidence to show that an hypercholesterolemia may exist without subjective symptoms. The probabilities are strong that in individuals in whom this diathesis is present, especially when such abnormality has its most common inception in a physiologic purpose (pregnancy), a certain amount of physio-

logical adaptation takes place so that moderate degrees of hypercholesterolemia are tolerated without the exhibition of any subjective symptoms. Only when the hypercholesterolemia reaches an extreme degree do symptoms appear. Possibly this accounts for the large number of patients in whom an hypercholesterolemia is present without any assignable cause and in the absence of any nephritis, atherosclerosis or diabetes. It seems not unreasonable to assume that the capacity for tolerance or adaptability for this disease should not be materially different from that present in other conditions of a similar order. When for any reason the retention of cholesterol bodies becomes extreme and beyond the capacity of the individual's adaptability, then subjective symptoms appear. The probabilities are strong that this happened in our patient.

The operative notes are as follows:—November 15, 1919. Exploratory laparotomy. Pericholecystic adhesions. Cholecystostomy. Fibroid uterus. Through an obliquely placed right rectus incision in the upper right quadrant of the abdomen, the peritoneal cavity was entered. The liver is normal. The gall-bladder of normal size, of normal blue color, contains no stones and the contained bile is easily expressible into the ducts. There are a moderate number of thin filmy adhesions between the gall-bladder and the adjacent viscera. The cystic, the hepatic and the common bile ducts are normal in every way and contain no stones. There is a fibroid condition of the uterus corresponding to the description in the physical examination. The rest of the abdominal organs are normal. A typical cholecystostomy was done, the tube being fastened into the apex of the gall-bladder with several purse-string sutures. The abdominal wall was closed tightly around the tube.

The post-operative notes are:—There was good recovery from the operation. The discharge of bile through the tube was profuse. At first the escaping bile was of a dark greenish-black color; very quickly this lightened considerably and within a week the bile was clear and of a golden-yellow color. It continued so until the drainage ceased and the wound closed. The wound was dressed in the usual way. With the exception of the drainage tract it healed by primary union. There were no complications of any kind during the healing of the wound and the convalescence. The patient was discharged cured on December 17, 1919.

The presence of pericholecystic adhesions has furnished material for discussion on many occasions. When the evidences of any previous exciting lesion are discernible, no difficulty is had in ascribing to the adhesions their proper interpretation. However, it is frequently difficult to say with any degree of certainty whether the adhesions are the scars of preëxisting lesions of the gall-bladder or of neighboring organs. Certainly adhesions of this kind can result from either. Occasionally the reason for the existence of these adhesions is not demonstrable at all.

In some previous unpublished studies it was possible to make out microscopically, crystals of cholesterol, or of other lipid, in the wall of the gall-bladder, or, grossly, upon its mucons surface, when there was no other abnormality to be seen. At that time it occurred to me that under proper conditions such deposits, however small they may be, could become sources of irritation. Such irritative lesions would be very apt to cause fine pericholecystic adhesions

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such as were seen in this patient without any other morphological change in the gall-bladder wall itself. A bile loaded with an excess of cholesterol would furnish a ready source from which these minute cholesterol crystals would be derived.

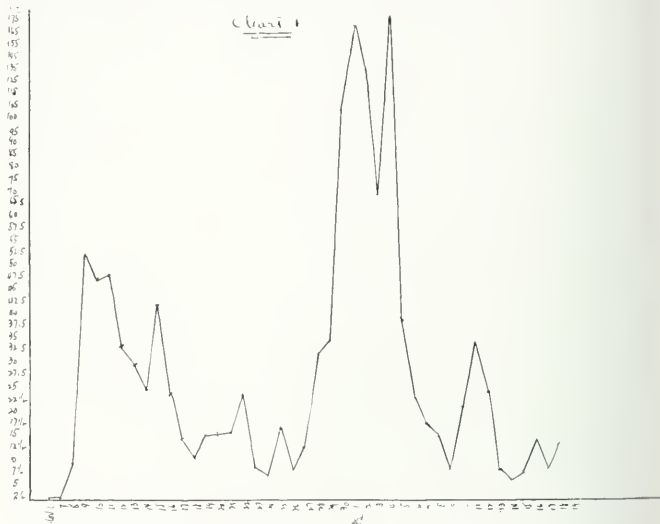
The following table and charts summarize the studies made on this patient directly after operation. TABLE I includes the post-operative facts in

TABLE I.

Date	Temp.	Diet gms.			Blood Cholesterol mg. per cent.	Bile Cholesterol		Biliruria
		Protein	Fat	Carbohydrate		c.c.	mg. per cent	
<i>Pre-operative</i>								
October	29	99.			0.242			
November	5	100.2			0.470			
<i>Post-operative</i>								
November	6	101.6		1.2	0.436			0
	7	101.6	11.7	1.7	260.3	190	0.197	0
	8	100.	31.5	9.	144.8	270	0.032	
	9	100.	28.4	52.3	164.2	170	0.043	
	10	100.	76.1	48.5	247.5	230	0.04	
	11	100.	29.	34.6	77.5	200	0.055	
	12	99.8	51.2	30.	253.	300	0.052	0
	13	99.6	45.2	26.	34.6	380	0.052	
	14	99.4	93.	42.2	124.2	350	0.060	
	15	99.4	38.4	23.4	42.2	0.182	96	0.088
	16	99.2				335		
	17	99.6	27.7	14.3	86.1	325	0.052	
	18	99.8	35.	11.4	205.	225	0.064	
	19	99.8	39.4	15.4	206.1	0.178	500	0.087
	20	99.5	39.4	15.4	206.1	325	0.064	
	21	99.5	42.8	16.5	271.	250	0.08	
	22	99.5	82.1	22.6	266.1	0.170	290	0.075
	23	99.6	53.9	8.2	382.4	300	0.082	
	24	99.6	59.1	7.	302.5	230	0.08	
	25	100.	70.3	17.0	403.	260	0.093	
	26	98.8	56.5	8.6	341.5	0.170	220	0.062
	27	99.4	97.6	12.8	381.7	190	0.034	
	28	99.	93.2	32.3	282.4	115	0.026	
	29	99.	54.6	35.9	184.4	110	0.026	
	30	99.2	98.5	100.8	297.4	0.248	210	0.014
December	1	99.2	112.	178.8	297.1	305	0.018	
	2	99.5	100.3	137.6	281.5	270	0.023	
	3	99.6	95.6	76.4	196.8	160	0.020	
	4	100.	107.6	180.	398.7	250	0.015	
	5	99.5	89.8	40.5	268.2	0.230	170	0.013
	6	99.2	84.8	21.4	506.	225	0.016	
	7	99.5	89.8	16.3	381.4	220	0.017	
	8	99.2	78.	9.4	500.2	200	0.019	
	9	99.6	57.8	22.	382.7	0.308		
	10	99.	71.	34.8	364.8	0.218		
	11	99.	75.3	34.7	557.3			
	12	100.2	36.8	25.	532.8	0.218		
	13	98.8	68.4	8.9	77.1	?	0.019	
	14	98.6	54.9	6.3	301.3			
	15	99.6	78.	8.1	488.3			
	16	100.2	93.8	13.8	458.3	0.172		
	17	100.	24.	8.5	505.8			
	18	98.	102.4	15.9	719.3			
	19	98.8			0.218			

regard to the changes in metabolism as shown in the blood and bile and the daily food content of fat, proteid and carbohydrate. At no time was there any evidence of any nephritis; and the blood-pressure was always within the normal limits. No abnormal glycosuria or glycolemia was ever demonstrable.

CHART 1 is a graphic representation of the daily variations in the fat content of the diet. In the first two days after operation, the diet contained no lipid. Thereafter a moderate amount of lipid was permitted in the food. Then this was purposely and progressively reduced until the twelfth day after



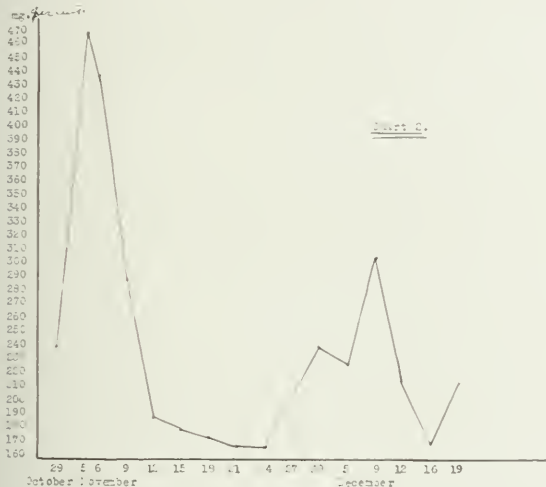
operation when minimum quantities of fat were being taken by the patient; this latter state continued for another nine days. Then large quantities of fat were given for nine days more with the purpose of demonstrating the change which was expected to follow in the cholesterol content of the blood and bile. In the final period the lipid content of the diet was again diminished to minimum amounts.

CHART 2 is a graphic representation of the post-operative daily variations of the blood content of cholesterol. At the time of operation the patient was apparently in an hypercholesterolemic crisis as shown by the abnormally large amount of cholesterol in the blood. Within the week following the operation and the institution of bile drainage, the cholesterol content of the blood fell quickly to the normal level. The fall to this low level in so short a time was undoubtedly entirely due first to the character of the diet in which only minimum quantities of lipid were permitted, and secondly to the drainage of bile

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which removed from the body, large amounts of cholesterol daily. Corresponding with the period in which the fat in the diet was increased to a large extent, the blood content of cholesterol rose until it reached almost 300 milligrams per cent.

CHART 3 is a graphic representation of the daily post-operative variations of the output of cholesterol in the bile. At the time of operation the bile was saturated with cholesterol bodies as shown by the first bile determination, 0.107 milligrams per cent. The patient was in the midst of her hypercholes-



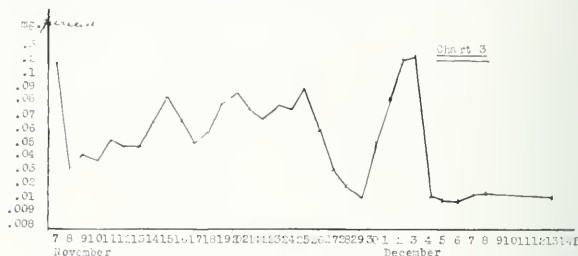
terolemic crisis. Immediately after operation there was a marked fall in the amount of cholesterol excreted in the bile. This was due to the toxic effects of the anæsthetic liberated in the liver cell environment which led to an inhibition of cellular activity. This laboratory observation corroborates the statement previously made in accounting for the beginning of symptoms after the operation for the umbilical hernia. The observed inhibition was a most temporary phenomenon and almost immediately it began to lose its effect, and the escaping bile showed a progressive increase in the amount of cholesterol excretion. Within a few days this reached a fairly constant level. At this constant level the bile was removing from the body slightly more than the quantities of cholesterol normally found in the bile. It, therefore, must correspond to a condition in which the body is very liberally supplied with cholesterol.

The period in which the excretion of cholesterol in the bile remained at this constant level corresponded to the period in which the lipid content of the food

was at a minimum. Towards the end of the period, the output of cholesterol in the bile fell to a level which is within the normal range, or slightly below it. In the absence of any replenishing supply in the food, it indicates that the supply of cholesterol in the body was approaching its normal amount, or that, possibly, the available supply was somewhat less than it should be.

Just at this time large amounts of fat were permitted in the diet and, corresponding with this increase, the amount of cholesterol excretion in the bile rose immediately to the constant level referred to previously. This indicates that the body was again liberally supplied with cholesterol.

As soon as the excess of lipid bodies had been removed from the food and excreted in the bile and the food again contained a minimum of lipid, the daily amount of cholesterol appearing in the bile dropped back to the exact low level at which it had been before the feeding experiment was begun.



Apparently, in this regard the excretion of bile cholesterol was a sensitive index of the amount of lipid in the food and, secondarily, of the amount of cholesterol in the body. It seems fair to assume that the variation in cholesterol excretion between the high and low levels as demonstrated in the experiment, and, graphically, on the chart, is the limit of physiological compensatory effort in the handling of lipid material in the metabolism of the body. These facts are true at least in this subject; and, in comparing the facts with those obtainable in animal experiments, it seems fair to assume that they would be universally true in other subjects.

CHART 4 contains the three curves referred to previously, cholesterol in the food, blood and bile, arranged together for immediate comparison.

A most interesting phenomenon occurred during the experiment. It will be noted from the charts that (1) the rise of the cholesterol content of the blood following the increase of the fat content of the food was only a little more than 60 per cent. of that which had been present before operation and during the hypercholesterolemic crisis; and (2) the daily output of cholesterol in the bile during the experiment was equal to that during the hypercholesterolemic crisis before operation. The significance of these observations is as follows:

The cholesterol cycle includes (1) a source of supply—the food; (2) an

importance. And the studies of Oertel, to which the views of Stadelmann and Eppinger, Jr., seem applicable, seem to show that some unknown activity liberated in the liver cell environment causes specific changes in the cell protoplasm leading, probably, to a decreased production, or, at least, to a lack of proper discharge of bile into the biliary passages and to a resultant retention of bile components in the blood stream. Just what this unknown activity may be I purpose discussing at another occasion.

It is noted in the charts that the observable manifestations in the blood took place appreciably later than the increase of the supply of fat in the food, while that in the bile was concomitant. The liver must, therefore, store up an excess of lipid. The blood crisis occurs, most probably, only when the capacity of the liver for storing cholesterol is overtaxed. This undoubtedly explains the fluctuations in the cholesterol content of the blood, especially for those times and periods in which a large excess (cholesterol crisis) is retained in the blood stream.

There are many factors which, to my mind, point clearly to the fact that the disturbance of metabolism leading to an hypercholesterolemia is a fatigue phenomenon. Rest corresponds to the period of normal cholesterolemia. In times of superabundance, the release from the body of any excess of cholesterol beyond the quantity which the body, in a healthy state, can normally handle favors the recuperation of the fatigued function and restores the metabolic activity to a normal state. Such restoration to normal active conditions—*i.e.*, the removal of excess quantities of cholesterol, can be accomplished by the drainage of bile, or by the curtailment, either partial or complete, of the replenishing supply of fat in the food source.

It is not to be assumed in any way that every case of pure hypercholesterolemia, in which the symptoms are referable to the disturbance of the cholesterol metabolism, should be treated by operation and relieved by the drainage of bile. Undoubtedly many of the disturbances are slight and are spontaneously corrected. Undoubtedly, too, many others can be relieved by proper dieting. Only a few will seem to be proper for surgical therapy, and, as knowledge increases, these, too, may grow less and less in number. I have in mind the method of bile drainage by the use of the intraduodenal tube; possibly for these cases the method may prove of value.

The subsequent history of this patient is that one year after discharge from the hospital she returned and was readmitted for the cure of the trigeminal neuralgia which had recurred. At this time there were no symptoms of any kind referable to the abdomen; in fact, the patient was most emphatic in her statement of the excellent result of the abdominal operation; the blood, however, showed a fairly large amount of cholesterol (0.412 milligram per cent.).

The question of how much the neuralgia was related to the hypercholesterolemia was referred to previously; it is of some importance. Neuralgias in other nerves of the body are known to be associated with other diseased condi-

HYPFRCHOLESTEROLEMIA

tions of a somewhat similar order in which toxic bodies of one kind or another are circulating in the blood. This is the first case that has presented itself in which a neuralgia was associated with an hypercholesterolemia. It seems altogether premature, however, to express any opinion concerning the causal relation between the two until a larger experience is available.

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THE MELTZER-LYONS TEST IN THE DIAGNOSIS OF GALL-BLADDER DISEASE

By B. F. SCALEFE, M.D.

OF NEW YORK, N.Y.

FROM THE SECOND SURGICAL DIVISION OF THE NEW YORK HOSPITAL

AN increasing interest has been shown by the medical profession as to the value of the Meltzer-Lyons test in the diagnosis of diseases of the gall-bladder, and a series of tests were made by the Second Surgical Division, New York Hospital, under Dr. E. H. Pool's supervision.

The test is based upon the assumption that the gall-bladder is supplied by the para-sympathetic nervous system, and the sphincter of Oddi at the mouth of the common duct, by the sympathetic nervous system. Applying the facts made known by the "law of contrary innervation" Meltzer suggested that a strong solution of magnesium sulphate which would relax the sphincter of Oddi should cause simultaneous contraction of the gall-bladder with consequent expulsion of its contents.

By collecting the fluid in the duodenum after such a saline lavage, a diagnostic test for diseases of the gall-bladder based on a study of the amount, character, cytology, bacteriology, cholesterin crystals, etc., might be possible.

A knowledge of the normal physiology of the biliary system must be present before any logical conclusions can be drawn from the results of the Lyons test.

The bile contains three important and characteristic groups of compounds—the bile pigments, the bile salts, and fatty materials, particularly cholesterin. The bile pigments are products of hæmoglobin catabolism. When hæmoglobin is decomposed the hæmatin portion of the molecule is utilized by the liver cells in the formation of the bile pigment bilirubin. After the passage of bilirubin into the intestines it is acted upon by bacteria and urobilin is formed. Part of the urobilin is excreted as such in the stools, some is taken up by the intestinal mucosa and is carried back to the liver by the portal circulation, while some may be absorbed by the general circulation and be excreted by the kidneys. The bile salts of glycocholic and taurocholic acids have much the same path. Thus, there is a continual circulation of the bile pigments and salts between the liver and intestines, aside from the cholesterin taken in the food, but little is known of its origin.

What is the place of the gall-bladder in this system? The older and less accepted views were that it was merely a "vestigial organ" or acted simply as a storehouse for bile.

Still other views held that it was an actively secreting organ, elaborating and adding something of importance to the organism. The last and most commonly accepted view holds the gall-bladder as a concentrating organ (Rous).

The gall-bladder is not absolutely essential to the well-being of the individual, as seen from the normal lives led by persons after complete cholecystectomy. However, the work of Rous disproves the theory that it is merely a vestigial organ.

Physico-chemical studies of gall-bladder bile show that nothing has been added to it except perhaps some mucin; the only change which has taken place is that the bile is much more concentrated.

The amount of normal bile secreted by an adult during twenty-four hours varies from five hundred to twelve hundred cubic centimetres. Comparing this relatively large output with the normal forty cubic centimetre capacity of the gall-bladder the impossibility of the "storehouse" or "reservoir" theory is apparent, for the gall-bladder could only contain from one to five per cent. of the twenty-four hour output.

Rous (R.-F. Institute) has definitely proven that the gall-bladder acts as a concentrating organ. The common duct of a dog is formed by the union of three large trunks, the gall-bladder emptying high up into the middle trunk. Thus a ligature appropriately placed diverts the bile from the liver into the common duct by way of the two outside trunks and into the gall-bladder by way of the middle trunk.

His analyses showed that the gall-bladder concentrates the bile received from the bile capillaries seven to eight times. The fact was also brought out that this concentrating activity is limited to the gall-bladder, the bile ducts tending to dilute the fluids they contain.

This concentration is generally conceded to be due to the rich lymphatic system which covers the surface of the gall-bladder.

The function of the gall-bladder might, then, be summarized as follows (Rous):

"The gall-bladder acts like a distensible bag interpolated into a rigid system of tubes to minimize extremes of pressure when bile comes rapidly or in large quantities from the liver, and its escape into the intestines is prevented by the sphincter. The bag in question is rendered capacious, not so much through its size as by a singular ability to reduce the bulk of fluid reaching it. The organ is also propulsive, delivering bile to the duodenum when needed. During those periods when the duodenum is empty the gall-bladder husbands the bile for future use and through its concentrating activity is enabled to retain very nearly all of the liver output when the interval from one gastric digestion to another is not unduly long."

That the gall-bladder empties itself by its own contractions has not been absolutely proven experimentally; its strongest contractions thus far having only equalled the secretory pressure of the liver. However, evidence on this point has been conflicting.

Whether the gall-bladder empties itself by syphonage, by pressure exerted upon it by neighboring organs, or by the force of its own contractions is not known. In our tests, the second portion of gall-bladder bile was separate and

distinct, as if the gall-bladder had emptied itself by its own contractions and had forced its contents into the duodenum. Hence, if these assumptions are correct, it is logical to regard the first yellowish-green alkaline fluid as the common duct or duodenal "A" bile. The more concentrated, viscid, darker second portion is regarded as coming from the gall-bladder, "B" bile. The third, watery, lemon-green fluid is regarded as coming from the hepatic ducts, "C" bile.

For the test the patient has breakfast omitted and the duodenal tube is swallowed about six inches past the stomach marking (40 cm.) and is then instructed to recline upon the right side with the hips elevated by two or three pillows. After twenty minutes the tube is swallowed to the duodenal mark (65 cm.) and the patient again reclines as before. This manœuvre is helpful because if the tube is swallowed at once to the duodenal mark it very frequently becomes knotted, whereas by the above method peristalsis takes the tube directly to the duodenum without much possibility of entangling it. Usually within one hour the tube is in the duodenum and the light yellow duodenal contents can be aspirated. The only definite way of ascertaining its position is by fluoroscopy, although the aspiration of yellowish-green alkaline fluid is usually sufficient.

After the tube is in the duodenum, about two ounces of 25 per cent. $MgSO_4$ is instilled, slight negative pressure given and the tube clamped off from three to five minutes. It is important that the fluid siphon off, as conclusions drawn from a test in which the fluid is withdrawn by repeated aspirations are frequently erroneous.

It has been repeatedly stated that the duodenum in the fasting state contains no bile. We have never found this to be the case, it may be the presence of the tube stimulates the excretion of bile. The common duct or duodenal bile has varied greatly in amount in different individuals, ranging from one-half ounce to five or six ounces. Normally it is rather clear, slightly viscid, alkaline yellow-green fluid with only a slight amount of epithelial debris and only a rare colon bacillus. No cholesterin crystals or leucocytes.

The second portion or gall-bladder bile is usually sharply differentiated from the first portion, it is more viscid, darker, often "tarry" colored and contains more bile-stained epithelial debris than the first portion. It contains no cholesterin crystals or leucocytes. An occasional colon bacillus may be seen. It is usually from one to three ounces in amount.

The third portion is usually only a few cubic centimetres in amount, is watery, lemon-green, or straw-colored. It also is negative to microscopic examination.

If one secures by siphonage the three types of bile, then one can assume that no obstruction is present.

If in a good test no gall-bladder or "B" bile is secured, then one assumes an obstruction of the cystic duct.

DIAGNOSIS OF GALL-BLADDER DISEASE

If the "B" bile is filled with clumps of cholesterol crystals, then a diagnosis of cholelithiasis is made. If the clumps of cholesterol crystals are scattered through both the first and second "A" and "B" biles, then there are probably stones both in the gall-bladder and common duct.

A diagnosis of cholecystitis without stones is made on the presence of abnormal amounts of bile-stained epithelial debris, abnormal number of bacteria and leucocytes. There are no cholesterol crystals present.

A pre-operative diagnosis of "mulberry stones" was made in one case on the presence of thorn-apple or ammonium biuret crystals in the "B" bile, this was verified at operation.

In a case of "strawberry gall-bladder" with the lipoid deposit in the tips of the villi and deposited in the subepithelial tissue, attention was called pre-operative to the enormous numbers of fat droplets in the "B" or gall-bladder bile.

The Lyons test was done in twenty-two cases in this series. Fourteen of these were operated upon. A diagnosis of chronic cholecystitis was made in nine (9), all of which were verified by the operator and pathologist (100 per cent.).

A diagnosis of cholelithiasis was made on the test findings in four cases, stones were found in these but also in two others. One of the cases missed contained a single stone in the wall of the gall-bladder and had no cholesterol clumps in the bile (66 $\frac{2}{3}$ per cent.).

No "B" or gall-bladder bile was secured in two cases, one of these had had a previous cholecystectomy, the other was found to have a stone in the cystic duct.

Nine cases were diagnosed normal by the Lyons test. Four of these have had no return symptoms at our Follow-up Clinic. Three were tests upon medical cases with no biliary symptoms. One was on a case of pregnancy. The last test designated normal was on a middle-aged fat woman who clinically was typically a gall-stone case and was operated on for stones. A perforating gastric ulcer was found at operation; the gall-bladder, though covered with adhesions, was essentially negative.

In conclusion, we believe that although the Lyons test is not of the utmost importance in the differential diagnosis of biliary pathology, yet considerable important information may be gained from its use.

CHRONIC CHOLECYSTITIS WITHOUT STONE

By FREDERIC W. BANCROFT, M.D.

OF NEW YORK, N.Y.

ALTHOUGH much has been written on cholecystitis, many of us are at a loss to know in certain cases whether this is a real clinical entity. If it is, how are we to diagnose the condition, and having made the diagnosis, are we justified in performing a cholecystectomy? I refer to the type of



FIG. 1.—Normal gall-bladder removed at autopsy of traumatic case shortly after death. Thin stroma, narrow elongated villi; no round cells in muscularis.

case coming to the hospital with a history of repeated attacks of pain in the right upper quadrant which often radiate to the right shoulder-blade. There is often a history of vomiting and sour eructations. The attacks, however, are not as severe as those of colic due to the cystic obstruction.

Physical examination reveals as a rule a definite area of tenderness in the region of the gall-bladder. The leukocyte count is usually normal. If, at operation, the wall is definitely thickened and there are numerous adhesions

about the gall-bladder, one feels justified in performing a cholecystectomy. Frequently, however, the gall-bladder is found free from adhesions. It empties on pressure rather slowly, and the wall feels slightly thicker than normal. There may be areas of subperitoneal fat deposit as described by Deaver and Willy Meyer. If one opens the gall-bladder, it means that either a cholecystectomy or a cholecystostomy has to be performed. Is one justified, then, in opening the gall-bladder for inspection? Upon opening it, one frequently

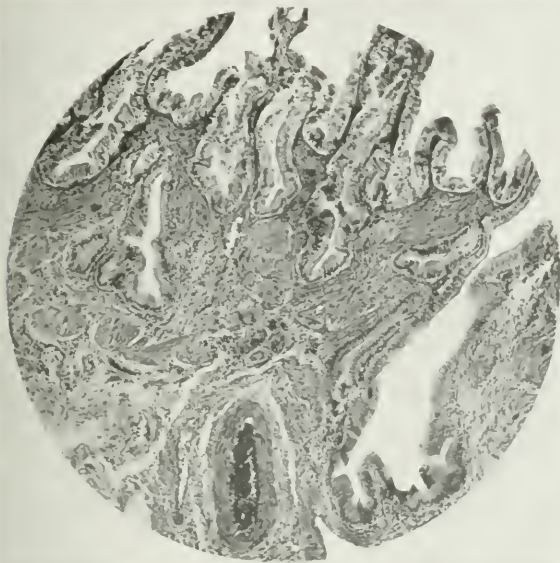


FIG. 2. — Chronic cholecystitis, severe. (a) Gall-bladder, 20 cent. in diameter. (b) Contains thick mucus. (c) Granulation tissue. (d) "Strawberry" appearance. (e) Numerous round cells in the lamina propria. Cholecystectomy. Patient well.

finds the picture of a strawberry gall-bladder: small, raised, pale elevations on a red background. In other cases, the mucous membrane appears relatively normal. What procedure should one adopt in the latter type of case?

The writer feels that perhaps a careful study of a series of 38 consecutive cases may aid in the solving of this problem. Cases which have been analyzed from a study of their histories, a study of the pathological sections removed, and an analysis of late results.

Conceptions of the pathogenesis of infections of the gall-bladder are based on four assumed possibilities:

First: A descending infection from the liver by bacteria carried down in the bile.

Second: An ascending infection from the duodenum up the common bile duct and thence into the lumen of the gall-bladder.

Third: A hæmatogeneons infection of the gall-bladder and its bile ducts.

Fourth: A spreading infection to the wall of the gall-bladder through the lymphatics from an inflamed contiguous organ.

The frequency of lower abdominal infections in association with gall-

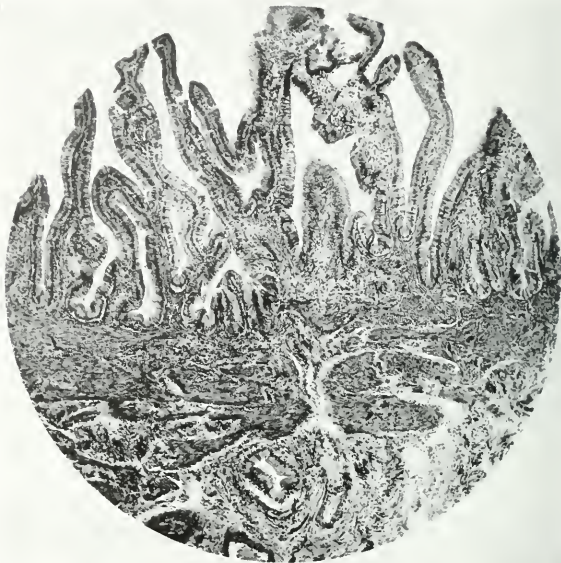


FIG. 3.—Same as Fig. 2.

bladder disease has led many surgeons to believe in the hæmatogeneons theory, but apparently there is no direct path from the appendix to the gall-bladder, for microorganisms passing up the portal vein go to the liver while the gall-bladder receives its blood supply from the cystic artery. One would assume, therefore, that the bacterial emboli would either have to pass through the liver capillaries and then reach the gall-bladder through the general circulation, or they would be transmitted through the finer bile radicals to the gall-bladder by means of the hepatic and cystic ducts.

Evarts Graham believes in the so-called hæmato-lymphatic route which was first suggested by Sudler. He has found by a series of experiments that

the interlobular lymphatics of the liver send branches over the gall-bladder. These in turn anastomose with the lymphatics which extend along the cystic and common ducts and ramify over the head of the pancreas. In cases of chronic appendicitis, Graham excised small pieces of the liver and found that there were numerous clusters of small round cells in the liver parenchyma.



FIG. 4.—First attack, although patient had suffered from indigestion for several years. Gall-bladder distended. Wall moderately thickened. On inspection, mucosa appeared normal. Mucosa intact. Numerous round cells over muscularis.

He was able also to produce experimentally in animals: hepatitis, cholecystitis and pancreatitis by injecting bacteria into the portal vein.

We have been surprised to find in the study of our cases the large percentage which had had either previous operations for inflammatory conditions of the lower abdomen or who had had a definitely diseased appendix removed at the time of operation. Our series, all from Doctor Pool's service at the New York Hospital, consists of 38 consecutive operative cases upon whom either cholecystectomy or cholecystostomy was performed. In three of the cholecystostomies, sections of the gall-bladder wall were removed for pathological examination.

Incidence.—There were 24 women, or 63.2 per cent., with an average age of 36 at time of operation. There were 14 men, or 36.8 per cent., with an average age of 36 at time of operation. The average duration of symptoms was $2\frac{1}{2}$ years.

History Analysis.—The chief complaint in this series was pain and soreness in the epigastrium or right upper quadrant. The pain radiated to the back in 24, or 63.2 per cent. of the cases. In 9 of the cases it was described as



FIG. 5.—Duration, one and one-half years of pain in right upper quadrant. Wall slightly thickened. No adhesions. Numerous round cells in villi. End result good.

dull, and in 29 as knife-like. Thirteen complained of indigestion and gas after eating, symptoms which had persisted over a considerable period of time. There was vomiting during the attacks in 19 cases, or 50 per cent. Eleven women and 5 men had had previous operations for inflammatory conditions of the lower abdominal organs. In addition, 5 women and 7 men had definitely diseased appendices removed at operation. This makes the total number of patients with inflammatory conditions of the lower abdomen 28, or 73.7 per cent.

Physical Examination.—Physical examination usually revealed patients with a moderate amount of adiposity. Usually they did not appear particularly

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sick. Rigidity was shown in a moderate degree in 9 cases; marked in 4; and absent in 25. Tenderness in the right upper quadrant at Murphy's point on deep pressure was noted in 35 cases and absent in 3. The ante-operative diagnosis was cholelithiasis 13 times; cholecystitis 15 times; adhesions about the duodenum 4 times; and ulcer of the stomach 2 times. In four the ante-operative diagnosis was not mentioned.

Operative Procedure.—Cholecystectomy was performed 31 times; chole-



FIG. 6.—Duration five years. Edema of mucosa. Thickening of muscularis with round cell infiltration. Cholecystectomy. Poor result.

cystostomy was performed 6 times; and inversion of a distal portion of the gall-bladder in a case of hour-glass constriction, once.

The appendix was removed in 20 cases and was found to be definitely diseased in twelve of the twenty as noted by the operator. Only definitely marked lesions of the appendix have been classed in this series as diseased.

Follow-up.—Thirty-seven of the 38 cases have been examined and personally seen in our Follow-up Clinic, for periods varying from 6 to 39 months. There was no operative death in this series. There have been three subsequent operations, one a case which came back for incision and drainage of an abdominal wound abscess three weeks after leaving the hospital. One

case developed a ventral hernia, and at a subsequent operation this was repaired. One case, cholecystostomy, came back complaining of pain. An operation was done, but the adhesions were so dense that no satisfactory operative procedure could be carried out. There were 7 cases classed as poor, making a total of 81.5 per cent. good results. Subdividing the series into operations, there were: 31 cholecystectomies with 4 poor results, or a percentage of 88.5 good



FIG. 7.—Duration, four months, strawberry gall-bladder. Moderate r. and cell infiltration. Some thickening of villi. Lipoid deposit shown with special stain. Cholecystectomy. Good result.

results. There were 6 cholecystostomies with 3 poor results, making a total percentage of 50.0 good results.

The case was classed as poor when abdominal pain and indigestion of varying degree still persisted. Five cases complained of indigestion and gas after eating. Eight patients complained of some upper abdominal pain. No history of vomiting was obtained in any of the post-operative cases. Eight cases still complained of constipation.

In analyzing the 4 poor results following cholecystectomy two cases were unimproved by operation and no satisfactory cause can be found. The other two cases were of a marked neurotic temperament. In analyzing the 3

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cholecystostomy cases, one came to subsequent operation for pain in the right upper quadrant. There was such a dense mass of adhesions surrounding the gall-bladder that it was impossible to perform a cholecystectomy.

Microscopical Examination.—Sections of all the gall-bladders removed have been studied microscopically. There is great difficulty in gall-bladder surgery in determining what might be considered a normal gall-bladder.

We at first attempted to study gall-bladder removed at autopsy in patients



FIG. 8.—Eight years duration. Gall-bladder found thickened at operation. No adhesions. Mucous membrane appeared slightly reddened. Knob-like villi with some ulceration of mucous membrane. Round cell infiltration. Cholecystectomy. Good result.

dying of diseases apart from those of the alimentary tract. As a rule, however, in a general hospital service, cases do not come to autopsy until several hours have elapsed after death. During this time autolysis has occurred and sections of the gall-bladder are useless for microscopic study. Due to the kindness of Doctor Symmers of Bellevue, however, I have been able to obtain some gall-bladders from traumatic cases that were autopsied shortly after death.

Figure 1 shows very clearly a gall-bladder which may be considered normal. In it, one can see that the villi are thin with a small amount of stroma and contain long columnar epithelial cells. The submucosa contains numerous

lymphatics and areolar tissue; the muscularis is not well developed and contains numerous blood-vessels and lymphatics. There is no infiltration or clustering of round cells. In studying the sections removed at operation, we have been impressed with the fact that there are apparently two types of lesions noticed. First, cases where the mucosa and villi are relatively normal but where there is thickening of the submucosa and areas of round cell infiltration in the muscularis and submucosa. In many places the lymphatics seem



FIG. 9.—Strawberry gall-bladder, one year duration. Thickened knob-like villi with edema and ulceration of the tips. Cholecystectomy. Good result.

distended with small round cells. In the second type, we find coarsely shaped villi often with ulceration of the tips accompanied with scar-tissue formation and round-celled infiltration. The latter type is the so-called strawberry gall-bladder and often shows lipid deposits in the villi.

Professor William Boyd studied 100 gall-bladders removed at operation. He found that there was an ester of cholesterol formed in the mucosa of the gall-bladder. When this formation is so marked in degree that the lipid becomes visible to the naked eye, it is usually called a strawberry gall-bladder.

He found on chemical analysis that a normal gall-bladder contained 1.70 per cent. cholesterol by weight, while the strawberry gall-bladder contained in

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the region of 50 per cent. cholesterol by weight. By staining methods in microscopic study, he found cholesterol in the epithelium of the villi and in the stroma, as well as in the fibro-muscular coat. These deposits may be either inter- or extra-cellular. He believes that the club-shaped villi are due to the cholesterol deposit.

Chauffard states that small biliary calculi were found to originate inside

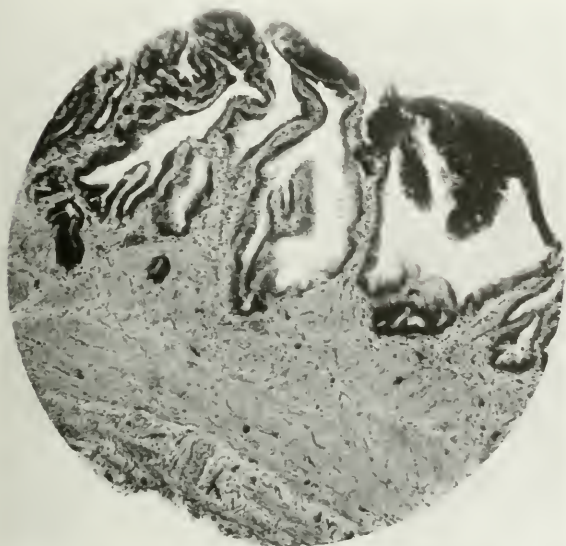


FIG. 1.—Duration one and a half years. Stain for lipid deposit shows knob-like villi with lipid deposit in mucosa and submucosa. Cholecystitis only. Good result.

the villi as minute clusters of cells surrounded by cholesterol. These are shed, then increase in size and ultimately become faceted.

From his anatomical study of the gall-bladder, Boyd believes that the delicate villi with thin-wall vessels running down through their centre can play no part as a reservoir. He believes they are constructed for absorption. In a series of experiments he injected 2 per cent. iron ammonium hydrate into the gall-bladders of dogs. These animals were killed at various periods of time from one-half hour to several hours after operation. The gall-bladder mucous membrane was washed and within one-half hour after operation numerous blue granules were seen in the epithelial cells and to a lesser extent in the stroma of the villi.

Doree fed dogs measured amounts of cholesterol and examined their

stools. He states that the amount found in the stools would only account for the amount of cholesterol in the food, and concludes from that, the bile cholesterol must be absorbed. Cholesterol is a monotonic alcohol which, on account of its solubility in fat solvents is regarded as a lipoid. Boyd summarizes his work as follows:

"First, the function of the gall-bladder is undoubtedly one of absorption,

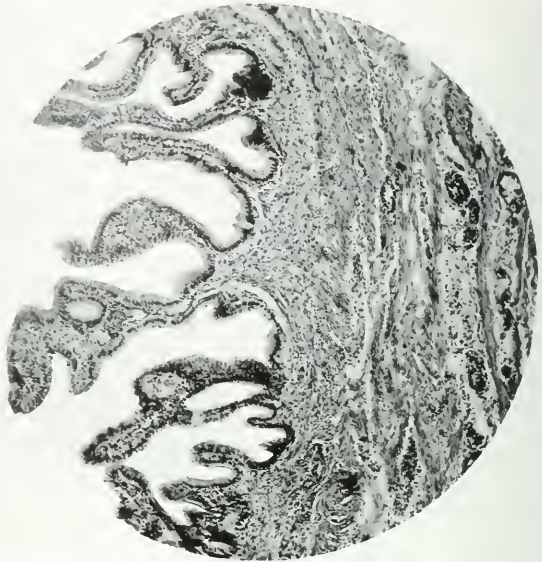


FIG. 11.—Same case as shown in Fig. 10. Numerous round cells seen in submucosa and muscularis. Cholecystectomy. Good result.

and it is possible that one of the several substances absorbed is the cholesterol of bile. Second, the deposit of cholesterol ester in the mucosa of the gall-bladder is an important feature in early cases of cholecystitis. Third, these deposits occur in the surface epithelium, in the connective tissue and possibly in the lymphatics. Fourth, in some cases at least the first step in the development of gall-stones may consist in this formation of cholesterol deposits."

CONCLUSION

We have assumed that the cases of round-celled infiltration in the submucosa and muscularis may be due to a lymphangitis secondary to liver lesions, while the strawberry gall-bladder type may be the precursor of stone

and may be primarily due to infection through the lumen of the gall-bladder. It is possible that these two pathological types may be various stages of the same disease. But as the duration of time is practically the same in both types, it is possible that they may be separate entities.

Diagnosis.—We believe that one is justified in making a diagnosis of chronic cholecystitis when there is a history of long-standing pain in the right upper quadrant which frequently radiates to the back. This pain is usually not as severe as the colic of cystic duct obstruction. Physical examination usually reveals tenderness on pressure over the region of the gall-bladder. The Lyon test has proved a distinct aid in the nine cases in which we have used it, as the diagnosis was made in 100 per cent.

Operation.—Cholecystectomy has produced good results in 88.5 per cent., while cholecystostomy, in the smaller series in which it has been performed, has not given good results, as only 50 per cent. were cured.

DRAINAGE OF THE COMMON BILE DUCT

A NOTE ON A METHOD OF REGULATING THE EXTERNAL DRAINAGE OF BILE

BY MONT R. REID, M.D.

OF CINCINNATI, OHIO

FROM THE SURGICAL DEPARTMENT OF THE UNIVERSITY OF CINCINNATI

THE operation of cystico-choledochostomy¹ permits an effectively closed biliary drainage system. The bile pressure following this operation can therefore be regulated in a very easy way. A reference to the drawing shows that by simply raising or lowering the drainage bottle, the pressure in the common duct can be varied. If the bottle is lower than the patient (the end of the tube being kept under water), a negative pressure can be produced in the common duct. When, however, the bottle is raised above the patient the pressure in the common duct will equal the weight of the column of bile in the tube. The normal pressure in the common duct is equal to the weight of an 8 cm. column of normal bile.

In my previous article¹ I advised clamping the drainage tube periodically on the third to sixth day after operation (depending on the pathological condition of the duct) in order to test the patency of the ampulla of Vater and to encourage the flow of bile into the duodenum. For a while, instead of clamping the tube, we connected the tube with a manometer and noted at what pressure bile ceased to drain externally. Whenever the pressure rose high enough to place too great a strain on the suture line the manometer was disconnected.

The present plan of regulating the bile pressure does away with the necessity of either clamping the tube or connecting it with a manometer. It possesses, moreover, definite advantages over both of the above mentioned methods for encouraging the bile to flow into the duodenum. For instance, the bile pressure varies; it is greatly increased when the patient coughs, sneezes or contracts his abdominal muscles. If the drainage tube be closed during a sudden rise of pressure in the common duct abnormal pressure will be brought to bear on the suture line in the duct or leakage might occur around the tube. When, however, the tube is raised above the level of the common duct to a point where the bile passes readily into the duodenum it will still act as a safety valve and allow bile to flow over into the drainage bottle when there is any sudden increase in the biliary pressure. If the bile has a free passage into the duodenum it will usually stand in the drainage tube about three or four cm. above the surface of the abdominal wall, the level of bile varying with respiratory movements. In several of our recent cases we have been able to

¹ Reid, Mont R.: Drainage of the Common Bile Duct Through the Cystic Duct; Cystico-choledochostomy. *ANNALS OF SURGERY*, April, 1921, p. 459.

DRAINAGE OF THE COMMON BILE DUCT

collect the bile externally or have it flow into the duodenum, as we chose, by simply varying the level of the bottle.

There can be little doubt that a serious toxic state occasionally follows the drainage of the common bile duct of deeply jaundiced individuals. This observation has been made by many surgeons with whom I have discussed the subject.

The etiology of such toxic states resulting from a sudden release of the bile pressure is not definitely known. Perhaps the liver cells, suddenly freed from



FIG. 1.—The insert illustrates the method of placing the tube in the common duct. By varying the level of the bottle one can regulate the pressure in the common duct. At position "C" a negative pressure might be produced if the end of the tube be under a fluid in the bottle. At "A" and "B" the pressure in the common duct will be determined by the height to which the bile rises in the tube.

the long continued back-pressure of bile, assume for a time an abnormally active function and deplete the body too rapidly of substances it has become accustomed to. Or, the removal of pressure may permit the liver and possibly the interstitial cells to absorb very rapidly toxic substances stored in the liver. A somewhat analogous observation is often made in cases of general peritonitis where an evacuation of pus may be followed by a profound toxæmia and death. In these instances the sudden release of pressure seems to permit an overwhelming absorption of toxic substances.

I previously drew attention¹ to the advisability of occasionally releasing gradually the bile-pressure in the biliary apparatus, especially when the patient is deeply jaundiced. This observation has also been made by Crile² and others. In such cases when free drainage begins to produce a toxic state the liver can be made to function against pressure by simply raising the drainage bottle well above the level of the patient, provided the bile does not pass readily into the duodenum.

²Crile, George W.: The Technic of Gall-bladder Surgery in the Presence of Jaundice. *Surg., Gyn. and Obst.*, 1921, vol. xxxiii, p. 469.

CALCAREOUS CHANGES OF THE GALL-BLADDER WALL

BY W. FRANK FOWLER, M.D.

OF ROCHESTER, N. Y.

SINCE the X-ray seems destined to play an increasingly important part in the diagnosis of cholecystitis any unusual röntgenological gall-bladder finding should be of interest.

Through the courtesy of Dr. Walter A. Calihan I was privileged to operate upon the patient whose history follows: Mrs. W., aged sixty-four years, the mother of two children, had suffered intermittently during the past three years with pain at the right costal margin. Sometimes the pain was sharp and localized; and again, a dull ache extended from this site across the chest and back between the shoulder-blades. Nausea and "biliousness" upon arising had been frequent. The appetite remained good but the tongue was often coated. Constipation had been marked for several years. Abdominal examination revealed merely tenderness over the gall-bladder region. The Wassermann test was negative. The X-ray examination by Doctor Davidson revealed a dense shadow beneath the rib margin, due, apparently, to a large gall-stone within the gall-bladder. At operation, July 31, 1922, the rounded fundus of the gall-bladder presented at the costal precisely in the location of the apparent stone shadow. Cholecystectomy was complicated by dense adhesions. The gall-bladder was somewhat larger than normal and looked and felt, both *in situ* and after removal, as though it tightly hugged a large stone. However, the pathological examination by Doctor Hastings, disclosed the true condition. It is reported as follows:

Gall-bladder 7 x 4 cm. Irregular pear-shaped, with a sharp constriction at a point one-third the length from the duct. Pale, with a hyperemic serosa. Very hard on palpation and evidently thick-walled. A slightly enlarged lymph-node is attached to one side. The tissue around the duct is very hard and firm. On section the gall-bladder wall seems stony and the contents below the constriction are found to be semi-fluid, containing a great amount of suspended matter which is finely granular with some coarser particles. Above the constriction the contents are a solid, friable, mortar-like mass, containing stones up to 7 cm. in diameter, and adherent to the wall. All the stones are soft and some are broken. The wall is from 2 to 4 mm. in thickness. The mucosa is apparently missing throughout. Occasional minute calculi are found imbedded in the wall close to the inner surface and there is extensive interstitial calcification. Microscopic: The gall-bladder wall is thick and made up almost entirely of extremely hyaline connective tissue. The mucosa is missing and there is a dense polymorphonuclear and endothelial-cell infiltration of the inner surface of the wall. A few calcified areas are found in the section. (A non-calcareous area was chosen for section.)

Osler observed that calcification of the gall-bladder commonly follows suppurative cholecystitis. There are two separate forms: incrustation of the mucosa with lime salts and the true infiltration of the wall with lime, the so-called ossification. Carman gives an illustration of the incrustation type and the gall-bladder herein described exemplifies the interstitial change.

Kaufmann, in discussing these lime deposits, states that as a result of chronic catarrhal inflammation, sometimes without stones, "the thick,

calloused, often entirely smooth wall can calcify (even ossify) and acquires thereby the appearance of an arteriosclerotic vessel wall." Kaufmann further observes that when calculi are present "in case the stones escape from the gall-bladder and an ulcerated inner surface remains, the lumen can disappear completely with adhesion of the ulcerated walls; the gall-bladder can transform itself into a bean sized, solid, fibrous, not rarely calcified structure." Sternberg



FIG. 1.—Röntgenogram showing dense shadow, due apparently to a large gall-stone within the gall-bladder.

notes that as a result of long continued chronic inflammation "the gall-bladder often becomes smaller and can, as a consequence of suppurative processes, shrink into a scarcely cherry-stone sized, dense, fibrous, not rarely also calcified body, enclosed in pseudomembrane, over which the edge of the liver appears notched. The lumen is in such cases fully preserved, obliterated, or still recognizable as a mere slit, in which

are to be found thickened, chalky, mortar-like or calcified masses. In case the gall-bladder contains concretions these are firmly embedded on all sides in fibrous tissue."

Regarding frequency most röntgenologists agree that calcareous changes of the gall-bladder wall are rare. Pfahler, for example, says, "I have never to my knowledge found any calcareous deposits in the gall-bladder wall. It cannot be frequent, for I make a gall-bladder study in every gastro-intestinal study and have done so for years." Crane states that he has no case on record of calcareous deposits in the gall-bladder wall. And Pancoast observes that he does not recall any case in which such deposits had been found. George in his atlas gives no illustration of calcareous changes in the gall-bladder wall. And Roberts merely hints at the possibility of a similar condition in the state-

CALCAREOUS GALL BLADDER WALL

ment regarding stones revealed by the X-ray that "Had the friable bilirubin calcium stones found at operation been in the form of sand they would have outlined the gall-bladder."

Cole, on the other hand, writes that "calcareous deposits in the wall of the gall-bladder in cases where the organ contains debris and thickened, inspissated bile, is not an uncommon occurrence, but I do not recollect having observed calcifications of the wall of a gall-bladder containing approximately normal bile."

Roberts, in a personal communication, notes that he has observed calcareous deposits in the gall-bladder wall but only on a few occasions. Roberts can conceive of no way in which such deposits could, with any certainty, be differentiated from calculi lying free within the gall-bladder.

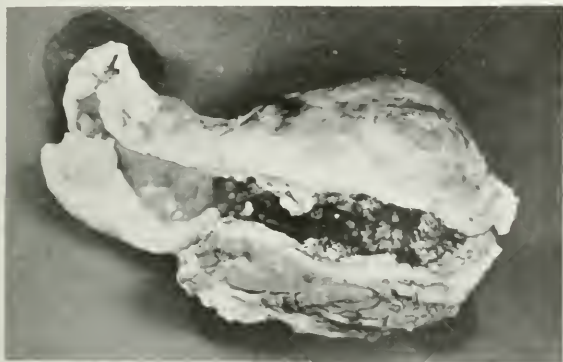


FIG. 2.—Excised gall-bladder showing thickness of the calcareous wall and the mortar-like mass within the organ.

Stewart "would not venture to say that we have ever been able to distinguish calcareous deposits in the wall of the gall-bladder from ordinary gall-stones. I have had one or two cases that showed large stones and then some smaller deposits which I felt were incrustations in the mucous membrane. Certainly, I have never been able to make a diagnosis of calcareous masses in the wall." George writes, "We have seen calcification in the gall-bladder wall occasionally though we never recognized the fact that it was definite calcification of the wall rather than stones until after the operation. In one or two instances we have found shadows which were not typical of gall-stones, and which proved to be calcification of the wall, so that the surgeon would have to scrape off the calcified material with a curette or spoon. In other instances we found impacted bile. I don't know as it makes a great deal of difference whether these areas are attached to the wall, in the wall, or free in the gall bladder. It represents pathology and, of course, that is our first endeavor. I do think,

now that this matter has been called to our attention, as it has been previously and now by your letter, that we keep this possibility in mind and at least be able to say that we suspect it in some cases by the appearance of it."

The rarity of the ossified gall-bladder from the pathologist's viewpoint is indicated by the fact that Reimann finds no record of a gall-bladder with generalized calcareous deposits in the wall.

Finally, a survey of the literature reveals few reports, from any source, regarding the calcareous gall-bladder.

Summary.—A woman who had borne two children exhibited the syndrome of cholecystitis during three years. The X-ray examination disclosed a dense shadow due, apparently, to a sizeable gall-stone. At operation and afterwards the gall-bladder looked and felt as though it contained a large calculus. However, incision of the organ and microscopical examination revealed generalized lime deposits within the gall-bladder wall.

Ossification of the gall-bladder follows chronic, usually suppurative cholecystitis. This calcification is rarely encountered by the röntgenologist, the surgeon or the pathologist. The röntgenological differentiation between a large stone within the gall-bladder, loose sand outlining the organ, or incrustations upon or interstitial deposits within the gall-bladder wall is difficult if not impossible. In the interest of accuracy, however, the appearance of the shadow might sometimes suggest calcification of the gall-bladder wall.

The writer expresses his indebtedness to Drs. S. C. Davidson and Willard S. Hastings, for their coöperation in the preparation of this paper.

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ANEURISM OF THE RENAL ARTERY

AN ANALYSIS OF ALL CASES IN THE LITERATURE WITH A REPORT OF A CASE
AND A DISSERTATION ON THE ETIOLOGY, PATHOLOGY, SYMPTOMS,
DIAGNOSIS, PROGNOSIS, AND TREATMENT OF THIS CONDITION

By MICHAEL J. CONROY, M.D.

OF BOSTON, MASS.

FROM THE DEPARTMENT OF PATHOLOGY, HARVARD MEDICAL SCHOOL

IN the performance of an autopsy recently on an elderly woman, a pathological curiosity whose existence was totally unsuspected during life was unearthed, an aneurism of the renal artery. Because of the rarity of the condition and the significance that it can sometimes be to both surgeon and patient, it seemed worth while to ferret out such scattered scraps on the subject as the past has bequeathed us, and by an analysis of them to try to derive something that may be of value.

The first published description of a case came from the pen of Daniel Nebel and is to be found in the *Academia Cesareæ Leopoldina Caroline Naturæ Curiosorum Ephemerides*, Centuria IX and X. This aneurism was disclosed in the year 1717 in the person of a medical man. Since then, 30 other cases have been published, the last one in 1919 by Orth, so that the present case report will bring the entire number of published cases up to 32. The incidence of this condition is, therefore, very small, and a cursory glance through the literature on aneurisms in general would leave one with the impression that, when compared with those of other vessels in the body, aneurism of the renal artery is one of the rarest types, if not the rarest, known to occur. Oestreich was of this opinion and there are a few published statistics bearing on this point. Thus, in 6,425 autopsies done at the Pathological Institute of Jena, Müller found 171 aneurisms, of which only three were located on the renal artery. Bosdorff at the Institute of Kiel found 93 aneurisms in 3,108 sections, not one of them being renal. And Emmerich discovered but one renal aneurism in 58 aneurisms of all types occurring in 8,669 sections. With these statistics as a basis, the occurrence of renal among aneurisms in general as met with at autopsy is 1.2 per cent.

Since more or less complete collections of the hitherto published cases have been previously made by Ziegler, Morris, Keen, Skillern, Trulli, and Vogeler, it will serve no purpose here to repeat work already well done and available for reference. So, a complete resumé is omitted, a report of only my own case being set down in detail. In order, however, to furnish a check upon the accuracy of the construction of the appended clinical picture of renal aneurism, in which direct reference is made—in enumerating the types of aneurism, symptoms, signs, etc.—to individual cases, some sort of tabulation of them is necessary for purposes of reference. The following table is, therefore,

constructed, the cases with two exceptions being numbered in chronological order. The name given is that of the author who published the case and the date is the time of publication. The division into "traumatic" and "spontaneous" is utilized to separate the aneurisms due to trauma from those in which no traumatic history could be elicited. A specimen in the Museum of St. Bartholomew's Hospital (Catalogue, vol. 1, 1882, No. 1530) is not included in this number because an account of it has never been published. Morris described it as a small aneurism of a renal artery, the wall of the sac, as well as the adjacent part of the artery being thick and calcareous. Nor, in spite of the convincing clinical picture presented, is a case recently published by Vogeler included, for the diagnosis was not confirmed by either operation or autopsy.

Traumatic	Spontaneous
1. 1717. Nebel (referred to later by Titius).	18. 1803. Dourlin.
2. 1770. Rouppe.	19. 1820. Gossett.
3. — Rayer (case of Danyau's).	20. 1852. Leudet.
4. 1849. Mounier.	21. 1850. Danner.
5. 1884. Reeves (also reported by Turner)	22. 1885. Armstrong.
6. 1900. Murray (reported by Morris).	23. 1891. Oestreich.
7. 1868. Hilton.	24. 1900. Barnard.
8. 1891. Hochenegg.	25. 1900. Keen.
9. 1891. Gruber.	26. 1904 Higgins (also reported by Fulton).
10. 1891. Oestreich.	27. 1900. Engel.
11. 1894. Hahn.	28. 1909. Markley.
12. 1900. Morris.	29. 1916. Trulli.
13. 1900. Abbott.	30. 1916. Trulli.
14. 1906. Skillern.	31. 1917. Key and Akerlund.
15. 1916. (?) Penkert (from Trulli).	
16. 1916. Kaunitz.	
17. 1919. Orth.	

The following case of renal aneurism, the thirty-second to be reported, falls into the spontaneous group.

32. Through the courtesy of Dr. F. L. Smalley of Reading, Mass., I performed an autopsy on the body of a patient who had been under his care, Mrs. M. G., aged seventy-two years. She had had dysentery at the age of forty-five, followed by bronchitis of several years' duration, and pneumonia at the age of fifty-six. There had also been several mild "rheumatic attacks" accompanied by pains in both shoulders, elbows, knees and ankles, but nothing further to indicate that these were attacks of true rheumatic fever. Ever since her recovery from pneumonia, she had been troubled by slight dyspnea, and the ankles had swollen a little off and on, but only after she had been on her feet a great deal. Although the menses had ceased at the age of fifty-six, there had been a slight vaginal discharge, sometimes blood tinged, occurring about once a month from the time when she was sixty-two years of age, until her death, but no special attention was paid to this. Her fatal illness had its onset in April, 1920, when the left nipple became infected, along with the gradual development of a bluish nodule under the skin of the breast. During the following year, the patient lost ten pounds in weight. One year later, in April, 1921, she was referred

to the Massachusetts General Hospital for treatment. Examination at this time showed a nodule in the left breast, with slight retraction of the nipple, and a bluish discoloration of the skin over the tumor. There was no glandular involvement. The peripheral arteries were thickened and tortuous, the heart slightly enlarged, and the blood-pressure was 200/100. There was slight edema of the lower extremities with varices of both internal saphenous systems. A pelvic examination was not made. Shortly after admission a radical breast amputation was done and histological examination of the removed tissue showed carcinoma, with, however, no lymph-node involvement. Recovery was uneventful, and the patient was discharged to her local physician. While under his care, she gradually lost somewhat in weight, and developed sharp pains in the right shoulder and arm, these being set down to metastatic deposits in the cervical region of the cord. The patient continued to lose weight and towards the end had to be catheterized. Death occurred on February 10, 1923, some thirty-four months after the appearance of the breast tumor.

The autopsy was performed three and one-half hours after death and the following anatomical diagnosis will indicate the findings.

Anatomical Diagnosis.—Primary: A. Senility; scar of old radical breast amputation; metastatic carcinoma in the 8th and 9th dorsal vertebrae, adjoining ribs, and right humerus (primary in breast); emaciation; decubitus ulcer.

B. Generalized arteriosclerosis involving chiefly the coronary, splenic, and renal arteries; chronic interstitial nephritis; hypertrophy of left ventricle.

Subsidiary. Keratinizing adenocarcinoma of uterus; adenoma of kidney; *saccular aneurism of inferior branch of right renal artery*; encapsulated apical pulmonary tuberculosis; fibrosis of lower lobe of left lung; fibrous perisplenitis and perihepatitis; interacinar fibrosis of pancreas with slight hyalinization of insular tissue; acute purulent and necrotizing cystitis; varices of saphenous vein tributaries; edema of lower extremities; multiple cutaneous pigmented moles.

For the sake of brevity, a detailed orderly description of the viscera is omitted, but there are several interesting features of the case that deserve a little elaboration. In the first place, the patient had four distinct types of tumors, two of them malignant—the mammary and the uterine—and two benign, the adenoma of the kidney and the cutaneous moles. The uterine growth, which is a rather uncommon type, presented as a reddish-gray globular mass filling and distending the upper half of the uterine cavity. Histologically, it was composed of epithelial cells having an adenomatous arrangement, often with papillary infoldings and abrupt transitions from glandular structure to pearl formation—a type of growth which Ewing designates an adeno-acanthoma and which is, in his opinion, relatively nonmalignant. Further, this case raises anew the question of the vagaries of the distribution of arteriosclerosis. Here, it is the coronaries, splenic, and finer radicals of the renal arteries which are hardest hit, the former only in their larger divisions, the latter just the reverse.

But the most interesting feature, perhaps, from a pathological standpoint is an aneurism of an inferior branch of the right renal artery. When first palpated, this was thought to be a calculus within the renal pelvis for it was small, round, and of stony hardness. After removal, and careful inspection of the kidney, it is found to be a small aneurism in direct continuity with a branch of the renal artery, situated just distal to the origin of three branches of this vessel which run to the upper pole of the kidney, and having its origin from the superior of two inferior branches into which the main artery divides. It is covered by a very adherent, thin, fibrous capsule, which, when removed, leaves a smooth, yellow, oval tumor, 12 x 6 x 8 mm. in size and in consistency, so calcareous, that it is difficult to section. When sectioned, it does not collapse and in its cavity, which is

smooth-walled, there is but a drop or two of liquid blood. At its point of communication with the artery, the sac is 6 x 8 mm. in size. The wall varies from 1-3 mm. in thickness, the latter dimension being greatest at the latero-inferior portion. Histologically, it is composed of dense hyaline tissue, in which a great deal of calcific material and fat has been deposited. The wall is in direct continuity with that of the artery, but sections of it treated with an elastic tissue stain, show complete absence of elastic fibres in it.

As would be expected, this aneurism gave rise to no symptoms during life and was of no clinical significance. Both clinically and pathologically it is similar to the cases reported by Key and Akerlund, Leudet, Danner and Abbott, except that the latter's may have been traumatic in etiology. But it might well have become of vital importance if the patient should have sustained a trauma to the right side, for pathologically, it is practically a duplicate of the specimen uncovered by Barnard, which, when wedged against the liver by external violence, was so hard in consistency that it tore the liver and resulted in a fatal hemorrhage.

Etiology.—In the etiology of renal aneurism, of first importance is trauma, 17 of the 36 cases, or 56 per cent., having been due to this cause. Of the 17 cases, all gave a history of injury to the side, back or abdomen, and in 8 of the 15 cases in which a cause was definitely stated, ten were due to falls of various sorts, thus, fall from a horse (2 cases), fall downstairs (2 cases), fall from tree, fall athwart a gunwale, fall from ladder, fall on side, fall on back, fall from cart. In the remaining five, the following causes were operative: stab wound of abdomen, gunshot wound of abdomen, struck side against a counter, knocked down and run over by hand cart, struck by engine. Of the 15 cases in which no history of trauma could be elicited, 6 or 40 per cent., were associated with generalized arteriosclerosis which had involved the renal arteries in all but one case. And 9 cases, or 60 per cent., had occurred in patients who had had severe infections which either were of long duration, or had antedated the patient's death by a long period of time. Thus, three patients had had pneumonia; two endocarditis; two chronic nephritis; two malaria; one rheumatic fever; one lues; and one had pleurisy with effusion shortly before death, in some instances more than one of these affections having occurred in a single patient, as the figures imply. The possibility of antecedent infection is, therefore, probably of some significance in relation to aneurism formation. It appears to be of more importance in this series than arteriosclerosis, although, in view of the possibility of the latter affection being due in a large percentage of cases to infection, it seems superfluous to argue here for or against the relative importance of one or the other factor to aneurism formation.

Age Incidence.—Of the 17 cases of traumatic origin, no age was mentioned in three, *viz.*: 1, 2, and 16, the first of these having been referred to as a "medical man"; the second, as a "young boatman"; and the third was a soldier in active service and, therefore, neither very old or very young. But of the 14 remaining cases, the youngest was 15 and the oldest 56 years of age, with a general average for this group of 36 years. In only one of the 15 spontaneous cases was the age not given, Case 23, and here the patient was referred to as a "young man." Of the remaining 14 the youngest represent-

ative was 9 and the oldest, 82 years of age, with a general average of 56 years for this group. The average age incidence for all cases of both types in which an age was given is 46 years. So there is no characteristic age period at which renal aneurism occurs, the relatively greater frequency of cases of spontaneous origin in middle and advanced life being probably more apparent than real due to the fact that this type produces no symptoms, as a rule, and is only an



FIG. 1.—Small saccular aneurism of renal artery, located just distal to the origin of three branches going to the upper pole and on the upper wall of the superior of two inferior branches, into which the renal artery divides. The cut on the anterior surface of the kidney hemisects a small adenoma.

incidental finding at autopsy, which may have existed in the body for many years.

Pathology. Type.—From a pathological standpoint, renal aneurisms fall into the same two main divisions as aneurisms of other vessels, *viz.*: false, in which the sac is formed of surrounding tissues which have walled off the blood extravasated from the ruptured vessel; and true, in which the wall of the sac is formed of arterial walls, one of which at least is unbroken. So there is much more uniformity in structure of the wall of the sac in the latter type than in the former. Thus, as a rule the false aneurisms were large sacs containing blood and blood clot, situated in the region of the kidney and covered anteriorly by peritoneum which in some instances was densely adherent to the underlying sac. The latter, in some instances, was very large (Nos. 3, 4, 11, 18) and partly or completely filled one side of the abdomen, with resultant displacement of the abdominal viscera. In three instances

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(Nos. 2, 4, 18), the sac in its anterior was a large multilocular structure filled with blood and blood clot mixed with urine, with complete or nearly complete destruction of the kidney. In regard to those cases in which there was a large sac either adjacent to or surrounding the kidney, it is difficult, as both Morris and Vogeler affirm, to determine whether or not the renal capsule was fused to the wall of the sac with the extravasated blood within it, or whether the



FIG. 2.—A renal aneurysm. Showing its communication with the artery, its multilocular structure, and its fusion with the kidney wall.

latter was located external to the renal capsule and was delimited solely by neighboring tissues, usually the retroperitoneal tissue. In Cases 2, 5, 8, 11, and 25, it is very probable that the kidney capsule was actually a part of the sac wall, while in Cases 7, 12, 14, and 17 this point is impossible to determine with any degree of certainty. The majority of the false aneurysms, of which there are 18 in all, were produced by trauma, fifteen of this type having been due to this cause, the remaining three (Nos. 18, 22, 25) having occurred in the absence of traumatic history. Of the remaining 14 cases, thirteen are examples of true aneurism, eleven of which occurred without and two (Nos. 13, 16) with a history of antecedent trauma. The remaining case (No. 23) does not admit of proper classification because of the incomplete report given.

Size.—The majority of the false aneurysms are large, while in the case of the true aneurysms, the reverse is true. Thus, of the 18 cases in former group, in the 11 instances in which the size was fairly definitely stated, the dimensions

of the smallest (No. 8) were 15 x 10 cm., and of the largest (No. 4), 25 x 20 cm., and the latter weighed 3,490 grams. Many of them were described as "large," "the size of a child's head," "the size of an adult head," "filling the left abdomen." The true aneurisms, on the other hand, were small, of the 12 cases in which the size was definitely stated, the smallest was described as being "the size of a marrow-fat pea" and the largest as big as an orange. Five were reported as having been as large as a hazelnut. These aneurisms were usually hard in consistency due to a calcific deposit in their walls, and in some instances were, at first, mistaken for a renal calculus (Nos. 24, 31, 32).

Location.—Because of the large size of the sac, its adherence to surrounding structures, and the destruction of the kidney usually associated with it, it was impossible to determine the exact point of origin of some of the false aneurisms (Nos. 1, 3, 4, 8, 10). Five (Nos. 6, 9, 12, 17, 18) apparently arose from the main trunk of the renal artery; two (Nos. 15, 25) from one of its main branches; two (Nos. 2, 11), from branches located within the capsule; three (Nos. 5, 7, 14), from tears in smaller vessels in the renal parenchyma incidental to laceration of the kidney, itself; and one (No. 22), from an interlobular artery. Of the 13 true aneurisms, two (Nos. 9, 26) were located on the main trunk of the artery; three (Nos. 21, 28, 31), at its bifurcation; and the remaining eight (Nos. 13, 16, 20, 24, 27, 29, 30, 32), on one of its various branches.

Sequelæ.—Renal aneurism may give rise to several pathological consequences, chief of which, in the order of their importance are: (1) rupture into the renal pelvis, usually with resulting exsanguination via the urinary tract; (2) rupture into the peritoneal cavity; and (3) destruction of the neighboring kidney. In all, there are 13 instances of the former complication, two (Nos. 19, 27) associated with true and eleven with false aneurisms. In the latter group, the communication between sac and renal pelvis was definitely stated to have been traced in but four instances (Nos. 3, 4, 7, 10), but it seems fair to assume that in the seven additional instances in which a history of hæmaturia was given such a communication must have existed. There are but two instances (Nos. 1, 7) of rupture into the peritoneal cavity, and in both cases it was a false aneurism which had ruptured. Destruction of the kidney, partial or complete was quite a striking concomitant feature of the false aneurisms. In two instances (Nos. 3, 18) the destruction of the organ was complete, and it had entirely disappeared; in Case 4 it was converted into a large multilocular sac with but little bits of kidney substance in the various septa; in seven cases (Nos. 1, 5, 7, 8, 10, 12, 15) it was partially necrotic; in four instances (Nos. 11, 14, 17, 25), atrophic; and in three cases the condition of the organ was not mentioned at all. The true aneurisms, on the contrary, apparently resulted in but little damage to the kidney *per se*. No mention was made as to its condition in many cases. In Case 16 it was partially necrotic and in Case 21, atrophied.

Symptoms.—An attempt to search out and group into a composite clinical picture the symptoms and signs of renal aneurism unfortunately can not be based upon the history of the entire 32 cases, for in four instances (Nos. 6, 16, 22, 23) the history is entirely lacking and in three others (Nos. 1, 15, 26) it is very meagre. But the latter three cases will be utilized in so far as they go, thus bringing the total number available for analysis up to twenty-eight. Of these, in six (Nos. 13, 20, 21, 24, 29, 32) there were no symptoms or findings directly referable to the presence of aneurism, and indeed, this is no more than one would expect, for they were all very small true aneurisms, perfectly intact and spontaneous in their origin. The remaining 22 cases, however, presented definite symptoms and signs.

Pain and Hæmaturia.—The combination of abdominal pain followed within a short period of time by the passage of bloody urine is the most characteristic feature about the onset of the illness. This symptom complex occurred in 15 or 54 per cent. of the 28 cases in which a history was obtained (Nos. 2, 3, 4, 5, 7, 8, 9, 10, 12, 14, 17, 19, 25, 27, 30). Pain in itself is of little significance, for in 14 of the 19 cases in which it occurred (Nos. 1, 2, 4, 5, 7, 8, 9, 10, 12, 14, 15, 17, 18, 19, 25, 26, 27, 28, 30), it was associated with trauma or a sudden strain and might, therefore, have been due to an injury to intra-abdominal structures other than the renal artery and kidney. In other words, abdominal pain following immediately upon the receipt of an injury could not, in itself, justifiably lead to a suspicion of renal aneurism. In two instances (Nos. 9, 27), the passage of blood in the urine followed immediately after the onset of pain; in 9 cases (Nos. 2, 3, 7, 8, 10, 12, 14, 17, 30), within 24 hours; and in three cases (Nos. 4, 5, 19), within a week. Needless to say, the time relationship of the appearance of the hæmaturia to receipt of injury or strain was, in most instances, the same as it was to the onset of pain. In six cases (Nos. 2, 5, 10, 25, 27, 30) the hæmaturia appeared but once, and in three of these (Nos. 5, 10, 27), led to death by exsanguination within two weeks. In the nine others, the bleeding appeared on more than one occasion, the greatest number of recurrences having occurred in Case 8, in which the hæmaturia disappeared, only to reappear eight times over a period of twenty months; the shortest interval of freedom having been one month, and the longest, six months, the bleeding lasting as a rule 3 to 7 days in each exacerbation. This tendency of the hemorrhage to cease and recur is fairly characteristic, there being 9 instances of more than one attack (Nos. 3, 4, 7, 8, 9, 12, 14, 17, 19), each attack persisting over periods of time varying from a few days (No. 9) to three weeks (No. 4), with periods of freedom between attacks ranging from a few days (No. 9) to four and one-half years (No. 12). The quantity of blood lost during each attack was difficult to estimate because it was, as a rule, mixed with urine. Perhaps the least quantity lost was in Case 25, where the urine contained only a little blood on one occasion. In Case 3, 3 to 4 "palettes" of blood were passed at one time; in Case 27, the urine was filled with blood; and in four instances (Nos. 3, 7, 9, 19), clots were

passed. There are 11 cases (Nos. 3, 4, 5, 7, 8, 9, 10, 14, 17, 19, 27) in which the hæmaturia was profuse enough to exsanguinate the patient.

Minor Symptoms.—While pain and hæmaturia dominate the symptom complex of renal aneurism, there are a few symptoms of subsidiary importance brought out by some of the cases. Thus, six of the patients (Nos. 3, 4, 7, 9, 18, 19) complained of dysuria and three of them had to be catheterized. It seems reasonable to explain this on the basis of small clots having plugged the urethral orifice with resultant distention of the bladder. In addition, as would be expected, several of the patients, after repeated hemorrhage, complained of weakness and pallor and showed signs of collapse. Two of the patients (Nos. 1, 17) felt a throbbing in one side of the abdomen and one (No. 11) after having fallen downstairs, experienced the sensation of "a ball moving around in the abdomen" and actually palpated the tumor, herself.

Signs. Tumors.—On physical examination, the most constant and reliable finding is tumor. This was found by the clinician in 16 or 57 per cent. of the 28 cases with recorded histories (Nos. 3, 4, 5, 7, 8, 9, 10, 11, 12, 14, 17, 18, 22, 25, 28, 30) in contrast to the occurrence of hæmaturia in 54 per cent. of the same cases. While hæmaturia is, therefore, the most valuable symptom at our disposal for diagnosis, tumor is the most valuable sign, and of these sole two findings, tumor is, as indicated, a little the more reliable and constant and is, therefore, the most important single factor in the diagnosis of renal aneurism. Nor do the above figures properly convey its true importance, for in five additional cases (Nos. 1, 2, 6, 23, 26) it seems, from the size of the tumor met with at autopsy—in every case at least as large as an orange—that it could have been palpated during life and been an aid to diagnosis, if looked for. The tumor as encountered at the bedside usually occupied one of the upper quadrants of the abdomen and varied widely in its limits. The smallest palpated (No. 30) occupied the left flank and was described as being as large as an orange. The largest one encountered (No. 4) resulted in a bulging forward of the entire left abdomen and extended from high up under the diaphragm well down into the iliac fossa and for a considerable distance to the right beyond the midline. And between these extremes, all intermediary gradations in size were met with.

As a rule, the tumor was smooth in outline, firm in consistency, fixed in position, and did not move with respiration. In only one case (No. 11) was ballottement obtained on bimanual abdominal examination, and in only one other (No. 8) did the mass shift with change in posture. Usually, the percussion note over it was dull and neither bruit or pulsation could be detected in it, with the exception of Case 1 in which pulsation was distinct: Case 8 where it was indistinct; and Case 12 in which a systolic bruit was audible. This is explained by the fact that such a large layer of blood and blood clot intervene between the inner pulsatile portion of the tumefaction and its capsule that the relatively small excursions of the renal artery where it enters the sac are

deadened and prevented from being transmitted to the outer portions of the aneurismal sac.

The tumor was not tender on palpation except in Cases 3, 5, 8, 10, 31.

As would be expected, it can make its appearance with great rapidity following injury. Thus, in Hahn's case (No. 11) the patient fell downstairs, and upon arising noted a feeling as though a "ball were moving around in the abdomen" and she actually felt the tumor, herself, which the clinician reckoned to be the size of a child's hand. In some instances, the growth of the tumor remained stationary for a time—apparently due to organization of the clot in the ruptured vessel, only with a subsequent yielding of the clot after a slight trauma or strain or even in the absence of any apparent cause whatsoever, to take on renewed growth. This occurred after the following quiescent intervals: 9 days (No. 2); 49 days (No. 3); 2 months (No. 10); 6 months (No. 17); 8 months (No. 9). The significance of these facts was borne out by the post-mortem findings of sacs filled with both old laminated clot and fresh soft clot (Nos. 2, 3, 17).

Diagnosis.—Clinically, there is but one condition which a small renal aneurism might be confounded with and that is renal calculus. Indeed, in one instance (No. 31) the kidney was actually removed for calculus when a small aneurism was really present. In this case the history of hæmaturia and slight pain and tenderness in the loin, coupled with the X-ray finding of a small spherical shadow in the iliac region had led to the diagnosis of calculus. In a given instance, the differentiation might be difficult, but the sudden onset of severe pain, its sudden cessation, the presence of red corpuscles in the urine, and the recurrence of attacks would all point to calculus, for Case 31 was the only one of all the small aneurisms, in which hæmaturia and pain were present, and even in this instance, the hæmaturia was an observation on the part of the patient which examination of the urine failed to confirm, and the pain was very slight.

The large aneurisms, however, may offer a real problem in diagnosis, for they may simulate the clinical picture presented by (1) hydronephrosis, (2) renal neoplasm, and (3) ruptured kidney.

In the case of hydronephrosis, there is usually no history of antecedent injury and the hæmaturia is generally absent, or, if present, slight, while in aneurism, the reverse is true. Further, the hydronephrotic sac is elastic in contrast to the solid consistency of the aneurismal sac. The size of the former is also subject to marked variations in size due to alternating periods of retention and sudden passage of large amounts of urine, while in aneurism, this feature is lacking.

Renal neoplasm may be in a given case very difficult to diagnose from aneurism. The tendency of the hæmaturia to be preceded by a sudden abdominal pain and to disappear and recur, rather than to be constantly present; the sudden, in contrast to the gradual onset of weakness and anemia; the absence of cachexia; and the lack of tenderness over the tumor, all point to the presence

of aneurism in contradistinction to neoplasm. Further, the finding of metastatic deposits in other parts of the body would strongly prejudice one in favor of the latter condition.

As for ruptured kidney versus renal aneurism, it seems futile to attempt to differentiate them clinically, for nothing short of exploratory operation can settle the question. And after all, the differentiation is more of academic than practical importance. In both instances, there is a hæmatoma surrounding the kidney, and if the blood composing it had its origin in ruptured vessels within the kidney other than arteries, it is designated simply as hæmatoma, while if the source of the hemorrhage was an artery, the resultant extravasation is classified as false aneurism.

Prognosis.—Renal aneurism which produces symptoms is fatal in 100 per cent. of cases unless operation is resorted to, for in the 24 cases in which the symptoms complained of were referable to the aneurism, only the six who were operated on survived—the remaining eighteen having died of this condition. In some instances, a fatal outcome followed rapidly upon the onset of symptoms—thus in Cases 24 and 26, within two days. Usually there were several attacks of pain and hæmaturia over a period of several weeks or months, death finally having occurred from a large hemorrhage into the renal pelvis, retroperitoneal tissues, or peritoneal cavity. The greatest interval of time between the onset of symptoms and lethal exitus was 5 years (No. 12). The average duration of the illness, as based on 14 fatal cases in which this point could be determined was 283 days, and in all but three of these (Nos. 1, 9, 12) the total duration was 4 months or less.

Treatment.—For those aneurisms which give rise to symptoms, there is but one efficient type of treatment, as the outcome of 24 cases illustrates. All of these died except those six which had been operated (Nos. 8, 11, 14, 17, 25, 31), and in two instances (Nos. 12, 15) operation failed to avert the catastrophe. So, the mortality with operation is 33 per cent. In view of the 100 per cent. mortality if no radical measures are undertaken, surgical interference has, therefore, proved itself justifiable. The best procedure is apparently removal of the sac together with the kidney. This was successfully done by Hochenegg, Hahn, Deaver, Key and Akerlund and Keen. In the other successfully operated case (No. 17), Orth removed the contents of the sac and sutured the tear in the renal artery, and the kidney one year later was functioning pretty well. But this procedure should not be advocated, in fact Morris was inclined to deery it. The latter advocates an oblique lumbar incision at the start, and an extraperitoneal approach is made until the nature of the tumor is discovered. This can be done by nicking the sac, and if laminated clot is found further penetration of the sac should be desisted in for fear of starting a profuse hemorrhage. Once the growth is determined to be an aneurism, if small, the peritoneum is reflected medially and the sac together with kidney is removed extra-peritoneally. If the sac is large, a transperitoneal approach should be made by continuing the incision anteriorly. The

renal pedicle should be clamped before attempts are made to free the sac from surrounding structures. When this has been accomplished, the renal vessels and ureter are ligated, the pedicle severed distal to the ligatures and tumor and kidney removed in toto.

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THE TECHNIC OF RENAL AND URETERAL SURGERY*

BY JOHN H. GIBBON, M.D.

OF PHILADELPHIA, PA.

It has been fifteen years since the surgery of the kidney and ureter was selected as a subject for discussion by this Association and ten years since a paper dealing with operative technic has been presented. I propose briefly therefore to review some of the points in the operative technic of renal and ureteral surgery, based largely on personal experience and observation.

Kidney Exposure.—I think nothing in the way of improvement in exposure of the kidney has been presented in recent years. Personally I have found the suggestion of Wm. J. Mayo, namely, an incision beginning over the twelfth rib and dividing the arcuate ligament and the quadratus lumborum to be a valuable one. Since using this incision I have but once, and then without harm, injured the pleura, and have never found it necessary to resect the twelfth rib.

I am convinced that the abdominal route is preferable to the posterior route in many cases where one is sure that nephrectomy is necessary, as in large tumors, and where other abdominal lesions are present, and in certain cases of wound of the kidney and possible associated wound of the abdominal viscera. It is much easier to remove large kidney tumors by this route and to do the operation with less likelihood of disseminating the growth by breaking into it or by manipulation. If drainage of the kidney region is necessary after this method of approach, the drain can be carried out posteriorly through a stab wound and the field easily excluded by peritoneal suture.

However, one should not allow the fact that he has made an abdominal incision for the exposure of the kidney to influence him to do a nephrectomy for a kidney lesion which does not require it.

Exposure of Both Kidneys.—In 1906 (*Jour. A. M. A.*, vol. xlvii, p. 2047) Leonard Freeman published a paper advising the exposure of both kidneys in certain cases of tuberculosis, and I should like to commend this method when, for any reason, doubt exists as to which kidney is involved or as to the involvement of both kidneys. Of course one will have recourse to this procedure much less frequently now than formerly, owing to the improvement in diagnostic methods.

The following two cases illustrate the value of the method. In 1907, at the Pennsylvania Hospital, I had foolishly done a suprapubic cystotomy in a case of tuberculosis of the bladder. The bladder was so extensively involved that ureteral catheterization of the ureters could not be done either before or after the cystotomy. We suspected the right kidney was the source of the trouble, but were not certain, nor were we able to know that both were not involved. The

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right was first exposed and found to be extensively diseased; the left was then exposed and found to be normal; the right was removed. The double exposure added but fifteen minutes to the time of operation. Following the nephrectomy the suprapubic wound closed and the patient, a physician, made a rapid convalescence and has continued the practice of medicine ever since (sixteen years). In 1909, I operated upon him for tuberculosis of the costal cartilages. The wound healed promptly and he has developed no further tuberculous lesion.

In June, 1913, I operated upon Dr. W. for tuberculous epididymitis, one testicle having previously been removed for tuberculosis. While he was in the hospital he had an attack of renal pain on the right side and passed blood. I was sure that he had tuberculosis of the right kidney and wanted to operate



FIG. 1.—K. M., Pennsylvania Hospital, No. 197, 1922. This plate represents phosphatic stones, filling the pelvis and extending up into the calyces in such a manner as to give the appearance of a pyelogram and has been often so interpreted. Stones removed from right kidney by Doctor Billings, July, 1922. Stones removed from left kidney, March, 1922, through pyelotomy and from incisions through kidney substance. A handful of stones were removed. No sutures. Discharged March 31st. Death occurred two weeks after she returned home.

upon him, but he went home and I did not see him again until January, 1914, seven months afterwards, when he came to Philadelphia with a discharging suprapubic fistula. He had developed a tuberculosis of the bladder and a suprapubic cystostomy had been done for retention of urine. Repeated attempts by expert urologists to catheterize the ureters, even under general anaesthesia, were futile. I was sure the patient had tuberculosis of the right kidney, but I was unable to be sure the left kidney was not also involved. The left kidney was first exposed and found to be normal in every respect, except for a small fluctuating superficial mass. I thought this might be a hamatoma, due to traumatism in delivery, though this had been easy. The area was incised and a creamy pus escaped from a small superficial pocket which did not communicate with the pelvis or a calyx. The interior was wiped out with carbolic acid and closed by suture. The right kidney was then exposed, found to be extensively diseased and removed. The suprapubic wound healed and the physician returned against advice to his practice. He died a few weeks ago from tuberculosis of

the left kidney and bladder, but had continued to practice for nine years after his operation. The interesting point in this case was that, had we been able to catheterize the ureters, we would have believed the left kidney to be free from disease, nothing would have been done to it and the patient probably would not have regained his health, even for a few months. William J. Mayo's method of exclusion of the infected ureter after nephrectomy by threading it into a tube, which is brought out at the lower angle of the wound, would seem to be a good one.

Incisions for Removal of Kidney Stones.—Fifteen years ago in this Association a good deal of difference of opinion was expressed regarding the method of exposure and removal of stones from the kidney pelvis, the calyces and the kidney substance, but I think to-day there would be a pretty general endorsement of the views expressed at that time in a paper by Bevan, who urged pyelotomy and direct incision over the stone, should it lie in a calyx or in the parenchyma. The accurate localization of stones by the X-rays

certainly removes one of the reasons advanced for longitudinal section of the kidney. The multiplicity of stones or the large size of a stone in my experience does not call for the section of the kidney. I will show an X-ray slide of a case in which I removed sixty stones through two incisions in the kidney substance, and I have repeatedly removed enormous stones, which filled the pelvis and extended into the calyces, by carrying the pelvic incision up into the kidney substance, and am sure that this incision does much less harm, is accompanied by less hemorrhage and is followed by prompter healing than section of the kidney. Eisendrath has recently (*Surg., Gyn. and Ob., May, 1923*) described this incision and called it "Enlarged Pyelotomy." If it is necessary to carry the incision into the kidney substance, the retro-pelvic artery can be ligated before division. An interesting article on "Renal Function following Nephrotomy," by Magoun (*Surg., Gyn. and Ob., May, 1923*) gives ample proof, from a study of a series of cases at the Mayo Clinic, that complete section of the kidney is a far more dangerous procedure, both from the point of hemorrhage and subsequent function, than pyelotomy, or pyelotomy and several small incisions through the kidney substance.

I have no cause to change my opinion on this subject as expressed in a paper before this Association in 1913, and since that time have not once resorted to complete section of the kidney for the removal of stones. Where the parenchyma of the kidney is incised directly over the stone, the incision should extend in a line from the periphery of the kidney toward the centre of the pelvis and should be closed by mattress sutures.

One of the surprising things about pyelotomy and multiple incisions is the absence or short duration of urinary leakage. This leakage, I am sure, depends more on the way the opening is made than on the way it is closed. Figure 5 shows a large stone extending into a calyx. It was removed through an incision extending up into the kidney substance. No sutures were placed in the pelvic wound and yet there was only a small leakage of urine for two or three days. The incision should be made large enough for the removal of the stone and not enlarged by tearing. No forceps should be applied to the edges of the cut pelvis for retraction or for the control of hemorrhage. A clean incision heals readily while a ragged one, or one with traumatized edges, does not. I have made some very imperfect closures of the pelvic wound in which there was no leakage of urine. I am sure that in the past our gauze drains were responsible for the urinary leak. Even when a cigarette drain is used the exposed gauze at the end should not come in contact with the incision. Nearly any closed wound in a hollow viscus will leak if

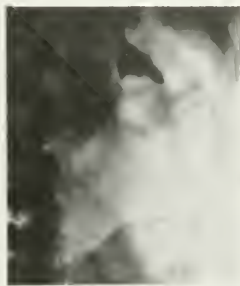


FIG. 2. F. D., Pennsylvania Hospital, No. 334, 1921. Large stone removed in three pieces through pelvic incision. One suture. No re- or urinary leakage. Discharged on fourteenth day.

gauze is placed against it. In kidney and ureteral surgery soft rubber drains should be used and lightly fixed, where wanted, with a small plain catgut suture, so that they can be easily withdrawn.

I believe that incision in the pelvis and multiple small incisions through the kidney substance are not themselves ever the cause of a fatality. We know that section of the kidney, even when no lesion is found, carries with it a definite mortality.

Bilateral Stones.—The presence of stones in both kidneys, in both ureters and in one kidney and the other ureter presents a problem which it is not easy to solve.

In our last discussion of this subject, Watson, of Boston, seemed to show

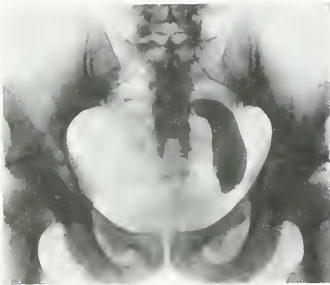


FIG. 3.—N. C., Pennsylvania Hospital, No. 407, 1921. Large ureteral stone removed March 16, 1921, by combined intra- and extra-peritoneal ureterotomy. Peritoneum accidentally opened but opening utilized to fix stone and ureter during removal. No sutures, urinary leakage for about a week. Phlebitis only post-operative complication.

that the simultaneous operation on both sides was safer than operating on one side and then on the other. The factor that will go furthest in deciding this important question is the function of the two kidneys. If renal elimination is poor on both sides and urea retention high, any operation is very risky. If elimination is normal, either method is practicable; but even here we will meet with occasional anuria after removal of stones from one side, and such a development calls for prompt operation on the other side. In looking over my records I find it has been my custom in these cases to

operate first on the side where the function is poorer and then on the other side. The situation and the size of the stones should not influence us too much, though, as a rule, where there is a renal stone on one side and ureteral stone on the other, the ureteral stone should be made to pass or be removed before doing anything to the kidney stone. One of the slides I show illustrates this point; although there was a very large stone in the right kidney, causing a great deal of pain and fever, with a large quantity of pus, the function of this kidney was better than that of the left, the ureter of which was partially obstructed by a stone which was causing no symptoms. The ureteral stone was removed and twenty-one days later the stone in the right kidney was removed through a pelvic incision carried up into the kidney substance for a short distance. The kidney wound was sutured but no sutures were put in the pelvic wound. Urinary leakage from the ureteral wound was only of two or three days' duration and from the right kidney for about the same period.

Fluoroscopical localization of stones on the operating table has been perfected by Braasch and Carman (*Jour. A. M. A.*, 1919, vol. lxxiii), and

in certain cases it must prove of inestimable value, as we have all been embarrassed by being unable to find a stone which has been apparent in a plate, or by being unable to assure ourselves that all stones, or all particles of a stone, have been removed. I have not as yet used this method of localization.

Nephrectomy.—Nephrectomy for stone is rarely necessary and should never be done unless we are quite sure the kidney is hopelessly damaged by infection or hopelessly injured by manipulation. Recently, for the first time, I was obliged to do a nephrectomy for a single stone because of injury I had done the kidney in delivery. It was in a second operation for stone, and the adhesions were very thick and dense. The nephrectomy was done because of bleeding.

One reason for being conservative in regard to the removal of the kidney is the fact that stones are very apt to be present or to develop in the other kidney. Braasch found bilateral stones in one out of six cases of renal stone at the Mayo Clinic. Another justification for conservation of the kidney is that it is difficult to prognosticate the future function of the kidney by a consideration of its condition at the time of the operation. One case which I had will illustrate these points very well.

I first operated upon Mrs. J., fourteen years ago (1906). She had an enormously distended and infected right kidney, due to a large stone in the lower ureter. It seemed as if all secreting substance had been destroyed, except a little good kidney structure at the upper pole. The kidney was drained and the ureteral stone removed by the combined intra- and extra-peritoneal method. Patient made a good recovery and there was no leakage from the ureter, which was not sutured. The kidney condition certainly might have justified a nephrectomy.

Four years later (1913) I operated upon this patient for a strangulated femoral hernia. Eleven years after the first operation (1920) I again operated upon her for a large stone filling the pelvis of the left kidney and extending up into the calyces. The kidney was badly infected and distended with foul pus and urine. The stone was removed in many pieces through a pelvic incision. Nephrectomy seemed indicated here but we had been unable to catheterize the ureters and did not know the function of the right kidney. The urinary output after this operation was normal and the patient made a good recovery.

Eighteen months after this operation (1921) I operated upon Mrs. J. again for acute infection of the gall-passages with jaundice due to stones; a cholecystectomy was done and patient recovered without any kidney or other complications, although there was a fair-sized stone in the lower pole of the left kidney at the time, evidently the result of leaving a small piece of stone at the last operation.

In May, 1922, I once more operated because of symptoms of intestinal obstruc-



FIG. 4.—N. C. (Mrs. J.). Hospital No. 440, 1921. Sixty stones removed, March 14, 1921. She pays for my and two other operations thirty-five dollars. No leakage of urine. A year previously these stones were the cause of kidney stones and a complete exploration of the gall-bladder made by another surgeon, who found the stones to be in the kidney but did not remove them. On removal, these stones were infected and to shape and color were exactly like gall stones.

tion, due to adhesions, and again she made a good recovery. This poor woman's life may not have been a happy one during the past fourteen years, but I think it illustrates the wisdom of avoiding nephrectomy in some cases where it would seem to be indicated.

Removal of Stones from Lower Ureter.—Strides have been made in removal of stones from the ureter since our last discussion of this subject. The non-operative method, the dislodgement of the stone with the ureteral catheter, resulting later in its passage, has removed from the field of operative surgery about one-half the cases of ureteral stone and represents a great advance in treatment. The size of the stones sometimes made to pass by

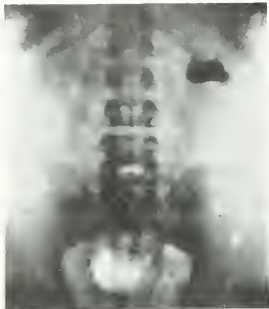


FIG. 5.—S. D., Pennsylvania Hospital, No. 752, 1923. Ureteral stone removed by extraperitoneal ureterotomy April 3, 1923. No sutures, some drainage but urinary leakage questionable. Kidney stone removed by enlarged pyelotomy April 24, 1923. No sutures. Discharge had urinary odor for three days, requiring change but once a day.

this method is quite surprising. But the remarkable success obtained does not mean that this method is always indicated or that even its trial is always justified. If attempted in cases not suitable for it, it may do harm and will in any such case put the patient through an unnecessary amount of discomfort. Braasch (Mayo Clinic, vol. xi, 1919, p. 267) says that when a stone has been lodged in the lower ureter from three to six months, or is more than 2 cm. in diameter, the possibility of dislodgement with the catheter is greatly diminished. Where there is a serious infection of the ureter or kidney, I think the method should not be used. However, in the majority of cases, if the stone is not too large and the evidence of infection slight, several attempts should be made to dislodge the stone. If these attempts are followed by much reaction they should be

discontinued and the stone removed by operation. If the stone is not too large to pass and its arrest in the lower ureter of short duration, neither dislodgement nor operation should be done, but a reasonable chance given it to pass. The drinking of large quantities of water will undoubtedly facilitate its passage.

In endeavoring to decide between dislodgement with the catheter and operation, one of the factors to be considered is experience. I would prefer the operation in experienced hands rather than dislodgement by an inexperienced cystoscopist, and the dislodgement by a good cystoscopist than operation by a surgeon without experience in this field. It may then very readily become a question of the man and not the method.

The mortality of the operation of removing stones from the ureter is practically nil. Judd (ANNALS OF SURGERY, 1920, vol. lxxi) reports 400 such operations from the Mayo Clinic with but one death. I have personally removed stones from the ureter in 22 cases with no deaths and the most

serious post-operative complication was a phlebitis. In none of these was there obstinate urinary leakage or infection. In the majority there was no leakage of urine and in others it lasted from two to ten days. The end results have been, I believe, remarkably good, though I have not been able to follow up all my cases. The technic of this operation has always interested me and I have presented to this Association and elsewhere several communications on the subject (*ANNALS OF SURGERY*, May, 1906, Surg., Gyn. and Ob., May, 1908, and *ANNALS OF SURGERY*, August, 1913).

The earlier routes for the removal of stones in the lower ureter, the vaginal and sacral, I think have been very properly abandoned, and I doubt whether even the vaginal route is ever justified, because it has been followed by more and longer urinary leakage than any other.

The most satisfactory incisions are a muscle-splitting one above and parallel to Poupart's ligament and the rectus sheath incision (Gibson's incision). When the peritoneum is reached it is reflected towards the pelvis until the iliac vessels and the pelvic wall below them are well exposed. The ureter adheres to the peritoneum and is reflected with it, making it sometimes difficult to identify and grasp. Its location can often be made out by palpating the stone, and if not it is most easily identified at the point where it crosses the iliac vessels. I have always located the stone with the finger before mobilizing or opening the ureter, and if this is not readily done I make a button-hole in the peritoneum, pass one or two fingers through it, locate the stone and push it up with the ureter until it can be seen or readily felt in the extra-peritoneal wound, where, without removing the finger which supports the stone, from the peritoneum, the ureter is incised and the stone removed. A gauze sponge is placed immediately over the wound in the ureter to take up any escaping urine and the ureter then closed with sutures, or a rubber-covered drain is fixed near the incised ureter without suturing. The finger in the peritoneum is now withdrawn and the button-hole closed.

Extensive mobilization of the ureter, I think, is a mistake and apt to delay healing. It can be avoided by using one or two fingers on the peritoneal side for support of the ureter in difficult cases. I have opened the peritoneum in about one-half my cases, but never do so if I can easily find and remove the stone without doing it. In no case has the stone ever been removed through the peritoneum and in no case has there been a peritoneal infection. I am sure the combined intra- and extra-peritoneal operation cuts down the time of the operation enormously in difficult cases. Twice in women where the stone was very low in the ureter, an assistant's finger in the vagina has been of great help in bringing the stone up into view in the extra-peritoneal wound.

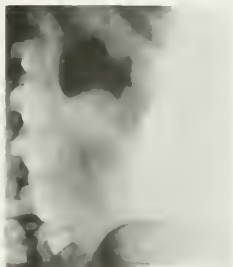


FIG. 6.—M. T. Perna, Calcutta Hospital, N. 1456, 1923. Two large faceted stones removed May 15, 1923, by percutaneous. Pelvis sutured. Urinary diversion dressings for three days only.

A dilated ureter makes its identification much easier and greatly facilitates the removal of the stone. In these cases I think it is often better to open the ureter a little above the stone and remove it with the Mayo common-duct forceps. If the stone can be pushed up to a higher point in the ureter without too much traumatism, it is better to do so, and to remove it through an



FIG. 7.—M. M., Jefferson Hospital, B-5242, 1912. Large stone, upper third of kidney normal, lower two-thirds destroyed. Sac containing stone drained after closing its communication with the pelvis. Late urinary leakage for a week.

incision at this point. In nearly all my recent cases I have put no sutures in the ureteral wound, many of which have healed without leakage and none of which have had any more leakage than in the cases where the wound was closed. The ureter should not be so displaced or twisted that the incision is made in its floor. The reason why leakage has been so troublesome when stones were removed through the vagina is probably because the incision is made in the floor of the ureter.

Everything that has been said about incisions, sutures and drainage in pyelotomy applies equally to the ureter.

In closing I should like to urge the advantages of the combined intra- and extra-peritoneal operation for stones in the lower ureter, where the stone is not easily found and removed through the extra-peritoneal wound. In my own experience it has made many difficult operations comparatively easy and has saved the ureter much unnecessary traumatism.

In order to rectify the misapprehension which has appeared in some textbooks, I should like to say that I have never advocated the removal of stones through the peritoneum and have never removed one by this route.

A CONSERVATIVE TREATMENT OF CARBUNCLES *

By RAYMOND W. LEWIS, M.D.

OF NEW YORK, N. Y.

INSTRUCTOR IN ANATOMY AND SURGERY, COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY

THE *usual* treatment of carbuncles as carried out at the Presbyterian Hospital during the past few years has been operative. Crucial incision to the limits of induration, with flap undermining, has been the most commonly employed procedure, with an occasional treatment by excision. These methods, while very effective in the majority of cases, are far from ideal because of their radical nature.

In reviewing the literature on carbuncles, I found many different conservative methods of treatment had been employed in isolated instances. Phillips¹ states that most carbuncles will heal up without operation, and advises the avoidance of operation unless there are special indications demanding it. Dennis² reports a case successfully treated by zinc ionization. Anderson³ used high frequency current on one case with excellent result. Picton⁴ gives the following prescription: "Paint them around with a ring of collodion. Paint them again each day, and each day encroach with your collodion ring more and more on the red surrounding areola. You will find that that is all that is necessary. They will get well." McIlhenny⁵ and also Dikshit⁶ advocate the use of Bier's vacuum hyperemia, and each reports two or three cases. Dodds⁷ reports a desperately sick patient with carbuncle of the face cured by administration of autogeneous vaccine. Walters, Coombe and Solly⁸ report recovery of a patient with carbuncle of the face, Ludwig's angina, and parotitis, following the use of autogenous vaccine, and citric acid given by mouth. Frick⁹ states that X-ray and leucodescent light seem failures, and passive hyperemia has not proven efficient. He concludes that vaccine treatment is the best method, and incision second best.

Three references were found to the use of X-ray, in addition to Frick's passing mention, given above. Coyle¹⁰ used it on three cases, of moderate size. The pain disappeared almost immediately, and they healed very rapidly without breaking down or discharging. Dunham¹¹ claims the successful treatment of sixty-seven consecutive cases of carbuncle. No protocols are given. His results: complete change in clinical picture within forty-eight hours. The first night after, the patient is more restless and sometimes believes the treatment has done him harm. The second night he sleeps well, the infected area ceases to be painful and the infected part can be moved without distress. From that time on, the principal object of treatment is to prevent reinfection. Sometimes the induration is gradually absorbed with little or no discharge. At other times it breaks down and discharges through numerous sinuses. But usually a large carbuncle will soften up and take on the appear-

* Abstract of cases omitted because of lack of space

ance of an abscess. In such cases it is a simple matter to lance it and permit free drainage. Almost no scar results from this treatment.

Ross¹² describes one case of severe carbuncle of the face and neck cured by use of X-ray.

I was impressed by the favorable, though few, reports of the use of X-ray. I received further encouragement to try this method from Dr. James A.



FIG. 1.—Case XVI. Twenty-two days after X-ray. Illustrating result on moderate sized carbuncles. Carbuncle 0x5 cm. at time of admission.

Corscaden, whose office I share, and who has had several successful cases of carbuncle treated by X-ray. He very kindly placed his machine at my disposal, and has given me most valuable suggestions and advice in the management of the sixteen cases I am here reporting.

The general plan of management of these cases has been as follows. First the administration of a two-thirds erythematous dose of X-ray, when first seen, or as soon as a diagnosis of carbuncle could be made. The following formula was employed: 90 kilovolts; anode skin distance 25 cm.; filter 1 cm. of wood, 6 mm. Bakelite, 1 mm. aluminum, 4 mm. leather; current $4\frac{1}{2}$ milliamperes. With this formula the erythematous dose is about 60 milampere minutes. In each of the cases here reported a dose of 40 milampere minutes was given.

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Immediately following the X-ray treatment, a dry dressing was applied, and the patient was asked to use flaxseed poultices at frequent intervals. Many of these patients, however, were so situated that poulticing could not be and was not done. The wound was dressed daily, and surgical indications carried out, such as removal of slough through existing sinuses, the enlarging by phenol of existing sinuses, or the drilling of new small sinuses by the tooth-



FIG. 2. Case X. Illustrating course of large carbuncle under X-ray treatment. Four days after X-ray. Size 15x7 cm. Localizing and softening

pick dipped in pure carbolic acid method, irrigations with Dakin's solution; later, strapping with flamed adhesive to promote epithelization, etc. Before and following the X-ray, only dry dressings were used, and great care was taken to avoid the use of irritants about the wound for fear of a resulting skin burn, as cautioned against by MacKee and Andrews.¹³

This series of sixteen cases was unselected, and consecutive except for two patients, not included, who expressed desire for incision, and upon whom I therefore operated. All the patients of the series showed multiple foci as manifested by numerous discharging sinuses. As it happened, only one, number 13, showed glycosuria, and this appeared only in one examination in his case. Stay in the hospital was indicated for only three patients in addition

to the two operated upon. Case number 9, because of high fever, toxæmia, and pain was admitted immediately, and remained three weeks. Case number 10 was admitted after ten days of treatment, when the process was well under control, largely because of homeless and destitute condition. He remained 19 days and benefited greatly from irrigations with Dakin's solution t.i.d. Case number 12 was admitted to a hospital 11 days after treatment,



FIG. 3.—Same as Fig. 2, six days later and 10 days after X-ray. Completely broken down and undermined, draining freely through multiple sinuses.

because of persistent pain, in order to have Dakin's irrigations t.i.d. to hasten the separation of a very deep seated slough. He remained 3 days in the hospital. Many of the patients carried on their work normally, only interrupting long enough to come in for dressing.

Only two of the series received operative treatment. The first was patient number 6, who came before we had sufficiently demonstrated the efficacy of the treatment to make us feel justified in carrying the patient through in the face of old age, temperature, toxæmia, and albuminuria, even though the carbuncle was reacting well following the X-ray, and had not increased in diameter. He was therefore operated upon on the second day following X-ray, a crucial incision with flap undermining being done. He made a long slow recovery.

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which was apparently not hastened by the X-ray. Had this patient come later in our series, I feel sure that he would not have received operative treatment at the time he did, for we subsequently treated larger and more serious carbuncles successfully by X-ray alone, cases number 9 and 10.

The second patient to be operated upon was number 14. He had a very deep-seated board-like, and sluggish process, which had not softened appreciably by the tenth day after X-ray. Though the spread was scarcely more than the usual, and though his condition was not unsatisfactory, operation to hasten softening and establish drainage was clearly indicated. Crucial incision with undermining was therefore done on the eleventh day after X-ray. For 5 days following this procedure there was no appreciable softening, then a very protracted convalescence and healing occurred.



FIG. 4.—Same as Fig. 3, twelve days after and twenty-four days after X-ray. Clean, granulating, beginning to epithelialize.

The behavior of these cases after X-ray was as follows: Redness, local swelling without increase in diameters, and elevation above surrounding tissues were distinctly increased in most of them 24 and 48 hours after X-ray. The diameters of the induration were increased in half the cases between the second and fifth day after treatment. In only two cases was this increase more

than 2 cm. in any diameter, and in many it was less. In the most severe case of the series, number 9, the only one where the spread caused any anxiety, the carbuncle had spread from 11.5 x 6.5 cm. to 13 x 9 cm. on the fifth day; and then, instead of stopping as did the others, it continued spreading, in one direction only, another 3 cm., until the measurements were 16x9 cm. on the



FIG. 5.—Same as Fig. 4. End result of Case X. Taken at follow-up, three and one-half months after X-ray.

eighth day. I think the probable explanation of this was the too narrow protecting in this case of the field of the X-rays in giving the treatment.

Suppuration and sloughing in the small and moderate sized carbuncles was surprisingly small in amount, and this took place through correspondingly small sinuses. This disproportion between, on the one hand, the size of the carbuncle, and, on the other, the amount of slough and size of the sinus is strikingly illustrated by case number 13. On the tenth day, when the induration was 8x6 cm., a slough 1 cm. in diameter was discharged through a sinus of the same dimensions, after which healing was rapid.

The duration of the sloughing process in the small and moderate sized carbuncles was short. Ten of this series could be considered under this classification according to size. With eight of these the sloughing was completed

within a week. In detail: Five had completed their sloughing by the fourth day; 2 by the fifth; one by the seventh; one by the tenth; and the 10th case, a very deep seated carbuncle, not until the fourteenth day.

The duration of the stage of granulation and epithelization in carbuncles of this size was usually short, because of the small size of the cavities left by sloughing and suppuration, and because of the slight destruction of epithelium in the formation of a sinus.

The very large carbuncles, illustrated by cases 9 and 10, resolved into enormous, sharply demarcated abscesses, a single cavity without demonstrable dividing septa. This occurred in 4 days in one case; and in the other, except at the point of spread referred to above, in 7 days. They then drained, with appropriate treatment, through sinuses formed by sloughing of the overlying skin, and went on to healing by granulation and epithelization.

Pain is the most important subjective symptom in cases of carbuncle. Relief from pain was experienced by the majority of this series of patients following the X-ray treatment. With four of the sixteen pain was not a symptom. Five complained of slight pain before treatment, and had no pain after. Three had had severe pain and had been unable to sleep. They reported that their pain was only slight following the X ray, and that they had slept well. One had slight pain which persisted after treatment. One had had very severe pain before administration of the X-ray, but for 24 hours succeeding the treatment he had complete relief. His pain then recurred, and was very troublesome intermittently until satisfactory drainage of the carbuncle was established. In the case of only two was no relief from pain obtained, and their pain persisted until free drainage was secured.

With regard to the total duration of the process, I was unable to make comparison with similar cases treated by operation, since accurate measurements of operated cases were not given, and the number of my own cases was too small. Insofar, however, as I was able to form an impression, it is my belief that the small and moderate sized carbuncles heal in a much shorter time with X-ray therapy than following operation; and that large carbuncles consume about the same amount of time with either form of treatment. But this is not of great value, as it is only an impression. Figure 6 gives the duration of my cases.

The cosmetic results of this form of treatment afford the greatest contrast with incision. Excluding the two cases operated upon, the end results of eleven out of the remaining fourteen are known, as regards scarring. Six out of these eleven, at time of discharge or at follow-up showed scars less than 1 cm. in diameter. Photographs of two of these are shown as examples (Figs. 1 and 7). Follow-ups were obtained on four out of the remaining five of this eleven. A photograph is shown of the largest of these cases, Fig. 5. The other three appeared as follows: One, seen 3 months after treatment, measures 4 x 1.5 cm.; the second, 11 months after X-ray, 2 x 1.5 cm.; the third, 10 months after treatment, 3.5 x 2 cm. All three of these scars were smooth, soft,

not depressed, movable over the underlying tissues, and only distinguishable from the surrounding skin by their pallor, their epithelium containing less pigment than the surrounding skin. All of these cases compare most favorably with the commonly observed results of operation, and with my two cases

FIG. 6.

Case number	Max. size.	Completely healed, after X-ray.	Notes.
1	6.5 × 5 cm.	11 days	None.
2	4 × 3 cm.	9 days	None.
3	4 × 3.5 cm.	Healing rapidly 9th day	Did not return, follow-up not obtained.
4	6 × 4 cm.	Shrinking rapidly 11th day	Did not return, follow-up not obtained.
5	9 × 7 cm.	31 days	None.
7	2.5 × 2 cm.	5 days	Small crust still present
8	5 × 3 cm.	14 days	None
9	16 × 8 cm.	47 days healed, except for one small quite resistant sinus $\frac{1}{2}$ cm. diameter. 70 days completely healed.	None.
10	15 × 7 cm.	52 days almost healed	Exact date could not be learned.
11	3.5 × 2.5 cm.	12 days	None.
12	5.5 × 3.5	36 days	Very deep seated.
13	8 × 6 cm.	19 days	Crust $\frac{1}{2}$ cm. still present.
15	4 × 4 cm.	20 days almost healed	Did not return, follow-up not obtained.
16	9 × 5 cm.	22 days, granulating area $\frac{1}{2}$ cm. diameter	Did not return.
		<i>Cases Receiving Operative Treatment.</i>	
6	10 × 9 cm.	62 days	Operative case.
14	9.5 × 8 cm.	77 days, healed except for small crust	Operative case.

which were treated by crucial incision. One of these, the third largest carbuncle of the series, showed 9 months after operation a crucial scar, wrinkled and depressed, 11 cm. transversely and 6.5 cm. vertically. The other, a slightly smaller carbuncle, 2½ months after operation had a depressed, wrinkled and puckered scar, 5.5 × 5 cm.

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The feeling of the patients toward the treatment is distinctly favorable. This applies especially to the patients who have suffered with previous carbuncles or boils, and have comparisons to make with other forms of treatment. Case number 8 had had a number of boils prior to the carbuncle, and at follow-up he volunteered the information that he much preferred the X-ray treatment



FIG. 7 — Case XI. Eight months after treatment. Showing end result on small carbuncles. Maximum size of this carbuncle was 3.5×2.5 cm.

to any other kind of treatment he had received. His scar measured $\frac{1}{2} \times \frac{1}{4}$ cm. 5 months after treatment, and was no larger than the scars of his boils. Patient number 7 had had many small carbuncles prior to the one reported. When he returned 48 hours after X-ray, with the slough out and the wound granulated level with the skin, he volunteered the statement that in each of his previous carbuncles this period had found him suffering severely, with the carbuncle at its worst, and his physician trying application of cups to bring relief and cure. Patient number 12, a physician, who had a very deep seated process, and whose pain had been the most prolonged and severe of any of the cases, and whom I therefore regarded as my least favorable successful case, stated at his follow-up, 3 months later, that he was very

glad he had received this form of treatment, because of the comparatively small and inconspicuous scar.

This would seem a relatively safe method of treatment. No bad results were obtained, although the series contained several severe cases, and two carbuncles of the face, which are well recognized as dangerous lesions. The comparative absence of traumatism to the lesions in dealing with them by this method, as compared with operation, would seem a protective measure of importance. Martin¹⁴ in his recent article on staphylococcus infections of the face and lips, has laid great emphasis on this factor of trauma. To quote him: "About every focus of infection a wall of leucocytes is rapidly formed. On the integrity of this wall depends whether or not the microorganisms advance into the tissues." He goes on to say that pricking, squeezing, incising, puncturing, or rough manipulations may break through the protecting wall of leucocytes and spread infection. He states: "I believe that early operations and rough manipulations in the infected area tend to spread, not limit, the infection."

SUMMARY

1. Only three reports of carbuncles treated by X-ray were found in the literature.

2. Sixteen unselected cases of carbuncles treated by X-ray are here reported.

3. Only two of these sixteen cases required operative treatment.

4. Diameters of induration increased more than 2 cm. after X-ray treatment in only two cases, and in one of these there was probably due to a too narrow protecting of the field of the X-rays in giving the treatment.

5. Sloughing and suppuration, and the skin sinuses through which this took place, were surprisingly small in the small and moderate sized carbuncles.

6. The very large carbuncles resolved into enormous, sharply demarcated abscesses, which drained satisfactorily through sinuses formed by sloughing of the overlying skin.

7. Pain was relieved following the X-ray treatment in the majority of the cases, but this did not occur invariably.

8. The duration of the small and moderate sized carbuncles seemed much shorter with X-ray therapy than under operative treatment.

9. The duration of the very large carbuncles seemed about the same with X-ray or operative treatment.

10. Cosmetic results of X-ray treatment were far superior to those of operation.

11. Great preference for the X-ray treatment was expressed by patients with experience in other forms of treatment.

12. The method seems relatively safe. The comparative absence of traumatism, as compared with operation, seems a protective measure of importance.

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CONCLUSIONS

This is obviously too small a series from which to attempt to draw any sweeping conclusions. Moreover, we have in these cases no actual proof of the value of X-ray, since it did not seem justifiable to run any control cases. Nevertheless, from the evidence submitted, we would seem justified in feeling that X-ray exerts a powerful influence on the progress of carbuncle. Though in a few cases operation seems unavoidable, X-ray in the majority of cases appears to bring a speedier cure, gives a far superior cosmetic result, and has been preferred by patients familiar with both methods. The comparative absence of trauma in this method, as compared to operation, is a protective measure. We would therefore conclude that in most cases its use is to be preferred to operation.

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There seems to be a great divergence in opinion as to the real etiology of the various types of diaphragmatic hernia. Hernias of the diaphragm are either congenital or acquired. From recent reports, the latter seem to predominate, but as these include the many cases observed during recent years when unusual acts of violence resulted in tears and other injuries of the diaphragm, seldom encountered during peace times, their proportion should gradually decrease.

In these cases there is no sac present, but various parts of the entire abdominal viscera are found to have migrated or to have been forcibly displaced into the thoracic cavity. If the injury was not fatal, and remained unrecognized, the condition usually becomes permanent as there appears to be no tendency for these tears to heal, or close.

In the congenital type, different factors prevail. Embryologically, the diaphragm is constituted of a ventral portion derived from the septum transversum and a dorsal portion derived from the primitive mesentery in which is contained the developing oesophagus and stomach. The hiatus-pleuro-peritonealis is closed about the fourth week of foetal life by a double fold of pleura and peritoneum. Muscle fibres are already present in the septum but not in the membrane closing the hiatus, which at the twelfth week appears as a transparent triangular area between the costal and spinal muscular origins.

The posterior portion of the diaphragm is the last to form. This is probably the reason why the diaphragm is often found incomplete at this point, a condition which permits the formation and development of diaphragmatic hernias. While the defect is present at birth, actual herniation may not occur until in later years. Herniation through the hiatus is perhaps the most common; especially is this true if all foetal cases be taken into consideration.

True hernias must not be confused with an eventration of the diaphragm. In the former, there is a direct communication between the abdominal and thoracic cavities. Because of the constant intra-abdominal pressure, there is a constant tendency for the abdominal viscera to pass into the thoracic cavity, should there be any defect in the diaphragm. In this instance, a sac is usually present, though it is seldom, if ever, as definite as in the case of an inguinal or ventral hernia. A congenital absence of fibrous or muscular tissue in the dome of the diaphragm leaves only a serous membrane to form the entire partition between the thorax and abdomen. As a result, the constant intra-abdominal pressure may produce an elevation of the dome and extend to various levels of the thorax. This bulging has been termed eventration, but it is questionable if it should be classed as a hernia.

In the true type, the stomach and colon are most frequently found to be herniated. From cases reported in literature, the small bowel, pancreas, liver, spleen, and even a kidney, have been found in the hernial sac. The position of the liver directly under the right dome of the diaphragm renders the possibility of herniation less than on the left, where but slight protection



FIG. 1—X-ray picture taken immediately following the taking of a barium meal, showing definite outline of herniated portion of stomach into thoracic cavity.



FIG. 2—Three weeks following operation. Hernia opening sealed. Sac absent.

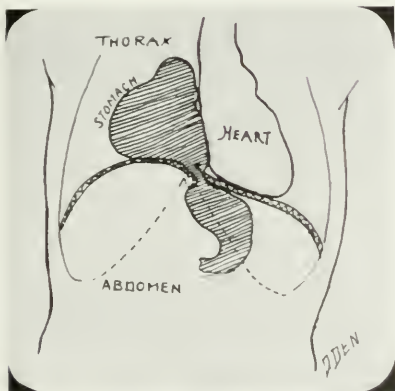


FIG. 3—Drawing showing extent of position of stomach in thorax and the site of hernia.

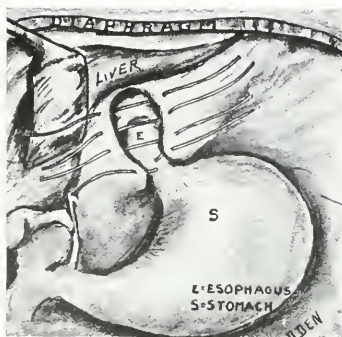


FIG. 4.—Stomach delivered into the abdomen. One inch row of sutures in place ready to be tied. Last stitch passes vertically through the outer walls of the cardiac end of the œsophagus, to prevent a future upward excursion of the stomach

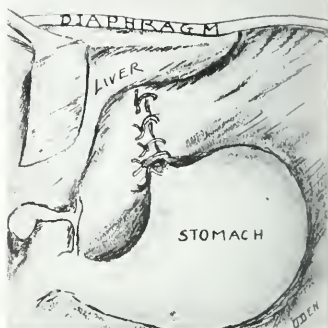


FIG. 5.—Sutures tied. Hernial opening closed

is present. Records describe several fetal cases where either detached lobes or the entire liver were found to be herniated, and in one instance, an autopsy of a man of forty-three, who had died from pneumonia, revealed a portion of the left lobe of the liver, together with the stomach and colon, was herniated through the left dome.

Herniation through the oesophageal opening has brought about some dispute as to the possibility of its being of congenital or acquired origin. Embryologically, as the stomach descends from its retro-pericardial position, it carries with it a portion of the peritoneum, a remnant of which may be found in the fetus on either side of the oesophagus and forms a sort of recess. This migration is usually complete before the final development of the diaphragm. If an improper migration occurs, the stomach, instead of the oesophagus, may occupy the oesophageal opening. This is in consequence enlarged to the calibre of the stomach, though some degree of constriction is usually present.

As the oesophageal opening is normally oblique, and situated in the thick muscular portion just above the crura, it is more likely that herniation at this point is due to developmental causes rather than to a gradual or sudden rupture because of increased intra-abdominal pressure. If trauma does occur, the weakest point, which is the dome, is most likely to give way and become herniated.

There seems to be a wide divergence of opinion on this point. By making an analogy between the oesophageal opening and the external abdominal ring as normal weak points, Bevan holds that hernias of the diaphragm occurring at the oesophageal orifice are always acquired. As in a majority of these cases there is present a definite sac, this view may be tenable, but because of the embryological development as described above, there is room for a divergence of opinion. We have reasons to believe that at least not all are acquired as many of the reported cases, both in infants and adults with definite histories, give conclusive evidence that they are of congenital origin. Then, too, a large number of cases referred to in literature were reports from fetal necropsies.

In numerous fetal cases reported, the whole diaphragm to the left of the oesophagus and left crura were absent. Such a condition would almost seem incompatible with life. However, in one of the three cases reported by Beckman, this gross anomaly was present in a boy of seventeen.

Symptoms and Diagnosis.—Depending upon the type and cause, various symptoms present themselves. In the traumatic type, the possible associated symptoms of hemorrhage, pneumothorax, possible collapse of the lung and shock, may entirely mask the real condition. If the patient survives, irregular disturbances of the digestive tract, dyspnoea, and varied cardiac symptoms may occur without any apparent cause. In either the congenital or traumatic type, the symptoms will depend largely upon the extent and location of the opening and the portion of the viscera herniated. The symptoms are usually chronic in nature, though acute manifestations occur occasioned by functional

disturbances. There may be present symptoms, highly suggestive of gall-stone colic, pyloric obstruction, peptic ulcer and other allied lesions.

Because of the varied anatomical possibilities, it is apparent that the same pathognomonic symptoms will not always be met with, but as in the relatively great proportions of hernias the stomach or colon, or both, are found in the thoracic cavity certain symptoms are usually constant. The patient will be hungry but unable to take quantities of food, because of the pain occurring in the epigastrium directly after eating. Associated with this there follows what the patient terms a sense of smothering or dyspnea and fullness; or pressure over the cardiac area, which in turn gives rise to great anxiety. This is increased if he is unable to vomit or belch gas, which is often rendered impossible, possibly by a spasmodic constriction of the diaphragmatic aperture. When calm and relaxed, vomiting may occur without any premonition whatever.

In view of the fact that similar observations have been noted in so many cases reported in literature, it is reasonable to ascribe epigastric pain directly after eating, inability to take quantities of food, a sense of smothering or precordial pain and distress, and inability to vomit or belch during an attack, as cardinal signs which point towards the existence of a diaphragmatic hernia.

A routine X-ray examination, including a fluoroscopic observation, is by far the surest method of making a definite diagnosis. In fact, with its use, it would seem almost impossible that a case could remain unrecognized, regardless of its history. Even though the patient presents symptoms suggesting a hernia, the definite diagnosis should rest upon the X-ray findings. If, in addition to the usual meal, a barium enema is also given, it is possible to obtain definite information as to the possible involvement of the colon.

Intestinal obstruction, strangulation and gangrene of the bowel or other involved viscera are the outstanding factors of risk to life.

Treatment.—Unless there should be some definite contra-indication after a diagnosis of diaphragmatic hernia has been made, surgical repair of the anatomical defect is the only measure to be considered. The hernia may be attacked either from above through the thorax, or from below, through a high abdominal incision. As the extent of involvement may vary to such a great degree and the types portray such a divergence of conditions, no one plan of approach would seem to be best suited to overcome all difficulties.

It is almost singular to note that in a majority of cases reported by American and British surgeons, the hernia was approached through the abdomen, while the French and Continental surgeons, including those from Scandinavia, favored the thoracic route. Fear of entering the thorax is no longer a hindrance. Since our experience in war surgery, invasion of the thorax in a liberal fashion has become more common, and it is safe to say that all hesitation will eventually disappear. The former fear of pneumothorax which was present in the minds of most surgeons has undoubtedly been a deterrent in years past. But regardless of the fact that the danger can thus be rendered to a minimum, still the abdominal route offers plausible

reasons for its use. If the table is raised so as to place the patient in a reverse Trendelenburg position, the tendency of the abdominal viscera to gravitate downwards offers definite advantages, otherwise impossible to be had. After the hernia has been reduced, it is no longer in the line of the rupture, but leaves the edges free to be sutured.

At all events, each case must be a law unto itself, and only after carefully ascertaining the extent of the involvement should any steps of attack be taken. To reduce the herniated viscera and to close the opening so as to prevent a future recurrence is the sole problem. If it is possible to overlap the edges of the diaphragm in a similar manner as used in the radical cure of an umbilical hernia, the possibility of a recurrence will be slight.

In case the hernia be at the œsophageal aperture, the closure can be accomplished to a greater degree of certainty, if as a special safeguard, the outer wall of the adjoining œsophagus be incorporated into the angle of the sutured diaphragm, as has already been described. This will remove all tendencies of a later upward migration of the adjoining viscera and materially hinder the tendency of a later recurrence of the hernia. Catgut is undoubtedly the best suture material to be used. In order to overcome and provide for a possible danger of a separation of the united edges, because of an unlooked for tension, it is good practice to use one or two linen stitches as an additional safeguard. At least it will relieve the operator of unnecessary worry.

The after-treatment is similar to that following a gastro-enterostomy. After the first twenty-four hours, liquids in small quantities may be given, at one hour intervals. The time and quantity is gradually increased as the patient progresses towards recovery. At least three months should elapse before full diet is to be permitted. Unless the patient will listen to reason and lend his coöperation, in this regard, there is a hidden danger that the resulting increased intra-abdominal pressure may become responsible for the undoing what otherwise would have resulted in absolute recovery.

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TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held May 7, 1923

The President, DR. JOHN H. JOYSON, in the Chair

TORSION OF THE TESTICLE

DR. ALEXANDER RANDALL reported the history of a youth, eighteen years of age, who first when fifteen, had an attack of rather severe pain in and slight swelling of the right testicle. The pain responded in about one hour to hot applications, and the swelling disappeared. Again during the same year he had a similar attack which required a hypodermic injection. This attack was over in about one-half hour. The testicle, however, he thinks, remained slightly larger after the attack. There was no further trouble until about three months ago, when he had an attack of dull pain in the testicle, which persisted for about a half hour. It was then normal until three weeks ago when, one week following trauma, the right testicle became painful and swollen, and somewhat reddened. The pain was dragging in character and persisted for about one week. It was treated with guaiacol and other ointments with no results. The testicle became about three times normal size, and this enlargement has persisted.

The right epididymis was enlarged to three times normal size, was firm, slightly irregular, not especially tender, except with deep pressure. Skin of scrotum seems adherent to tumor in the lower outer margin and there is a slight indication of redness at that point.

March 28, 1921, the affected testicle was removed. The removal of the testicle from the scrotum was hindered by a dense band of adhesion that grasped the cord as it entered the scrotum. It was necessary to cut this and to enlarge the incision downward in order to complete the enucleation.

On incising specimen in its long axis, the epididymis was found to be the seat of a generalized hemorrhage, its normal topography being lost in an extensive blood clot. No areas of suppuration were found. The testis itself is of a dark brown color, considerably necrosed and markedly friable. It was then realized that torsion of the testicle with gangrene was the lesion present, and it was possible to demonstrate complete twist of the cord, three-fourths rotated, at the point where the above-mentioned band was cut and immediately below the point where the cord was sectioned.

VESICAL CALCULUS

DOCTOR RANDALL presented a youth nineteen years of age, who supposedly contracted gonorrhoea in the summer of 1922, coincident with which he had pain and difficulty in voiding urine which has persisted and

BULLET IN THE BLADDER

grown worse to the present time. The passing of a metal catheter elicited a rough grating sensation on entering the bladder. X-ray showed a peculiar shaped elongated shadow of a mass within the bladder. The bladder was opened suprapubically by Doctor Siter, February 19, 1923, and a calculus of uric acid nucleus and phosphate outer layers was removed. The calculus that was removed measures $6\frac{1}{2}$ cm. in length by $1\frac{1}{2}$ cm. at its greatest diameter, and grossly resembles a man's little finger in shape and size. It is definitely formed of phosphatic deposits and is of a peculiar comma-shaped curve. On the surface of the large bulbous end may be seen a surface area which is polished and suggests either foreign body or ebonization. Hemi-section of specimen shows a small round calculus lying in the bulbous end of harder character and darker color and probably of uric acid composition. It measures $2\frac{1}{2}$ cm. by 1 cm. The remainder of the calculus is of soft phosphatic salts in composition. There is no evidence of any foreign body.

Evidently there has been a renal calculus passed without the usual symptoms of pain, and probably causing the discharge which had been considered gonorrheal. It was felt that such a calculus formation could occur only by the lodging of this calculus in a diverticulum or one of the urinary passage ways with the rapid deposit of phosphatic salts about it and behind it. Certain it would be, that if it were lying free in the bladder cavity, it would form a concentric stone of oblong shape as is frequently seen.

Before the patient was discharged a cystogram was made on the 21st of March and reported as follows: "The bladder is apparently well filled with the opaque solution. There is a circumscribed bulging area on the left side and a smaller one on the right, possibly diverticula. The entire anterior urethra, the bulb and particularly the posterior urethra are markedly dilated." This plate showed the diameter of the posterior urethra to be at least 3 cm. in extent, and it is my opinion that this calculus had lodged at this location at the time of the onset of his first symptoms; it being likewise interesting to realize that its further growth had probably taken place in the course of the following six months.

BULLET IN THE BLADDER

DR. LEON HERMAN reported the following case: Colored man admitted to the Pennsylvania Hospital in January, 1923. Patient had been shot some hours before, a bullet of .32-calibre entering the right hip. There was slight hematuria, and on examination it was noted that there was some swelling above the pubes. The X-ray examination revealed the bullet in a position apparently superficial. Doctor Mitchell explored suprapubically and found a hematoma to the left side of the bladder extending to the pelvic floor. Digital exploration did not locate the foreign body. The wound was drained and the patient made a prompt recovery with slight leakage of urine for the first thirty-six hours after operation. The patient was not cystoscoped prior to operation because of an acute urethritis.

Following the above procedure, a second X-ray indicated that the bullet had changed its position somewhat. Under the fluoroscope, it

was determined that the bullet could be moved by a finger placed in the rectum. Cystoscopy showed it lying on the floor of the bladder. The wound of entrance could be seen as a small, round reddened area on the right lateral wall of the bladder about one inch behind the vesical sphincter. The bullet was extracted through a suprapubic incision. Doctor Herman quoted Doctor Mullen of Idaho, as having had a patient in France, a soldier, who passed per urethram an ordinary rifle bullet, and Dr. Robert LeConte removed a stone from the bladder, the nucleus of which was found to be a grain of bird shot. The latter case was reported before this society some years ago.

VESICAL CALCULUS

DR. HERMAN presented a calculus which was removed from the bladder of a young man who was admitted to the surgical service of Dr. Robert LeConte in the Pennsylvania Hospital, complaining of great dysuria and frequency of urination. On examination it was found that he had extensive genital tuberculosis. The cystoscopic examination revealed what we thought to be a small contracted bladder. It was found impossible to get a view beyond the limits of the trigonum, and the presence of ulceration and intense inflammation of the bladder, together with the presence of advanced genital tuberculosis led us to conclude that we were dealing with generalized genito-urinary tuberculosis. The X-ray, however, showed the shadow of a stone, and the various examinations for the tubercle bacillus in the urine were negative. A suprapubic incision was made and this stone was extracted from what seemed to be the posterior pouch of a bladder divided by a septum. The latter may have been a greatly enlarged interureteric bar, but at all events it served to divide the organ into two compartments. The wound healed promptly and the patient left the hospital practically without bladder symptoms.

CALCULUS IN DILATED URACHUS

DOCTOR HERMAN presented a calculus to which was attached a history as follows: An Italian, twenty-four years of age, came to the out-patient clinic of the Pennsylvania Hospital complaining of dysuria and suprapubic pain. He stated that the diagnosis of bladder stone had been made ten years before. Cystoscopy revealed an intensely inflamed bladder and a small white object projecting from the orifice of a diverticulum at the summit of the bladder. The X-ray examination showed the presence of a very large calculus at the summit of the bladder. The stone was removed suprapubically when it was found that the urachus was markedly dilated and extended to the level of the umbilicus.

DR. CHARLES F. MITCHELL said that the first case reported by Doctor Herman was brought to the Pennsylvania Hospital with a bullet wound in the right buttock. He showed no abdominal symptoms and no blood was passed either from the rectum or bladder. Several days later a swelling appeared in the lower abdomen over bladder region and slightly to left immediately above Poupart's ligament. X-ray picture showed bullet lying about one-half inch within the abdominal wall. An incision

SPLENOMEGALY

was made over swelling and quite a large quantity of blood evacuated. There was no urine in the fluid and no sign or any extravasation in the tissues other than blood. The bladder wall seemed thickened and hemorrhagic. The bullet was not found and the operation terminated by simple drainage of the hæmatoma. He believed the bullet was lodged in the bladder wall at this time, and later ulcerated itself into the bladder where it was found at the second operation.

SPLENOMEGALY

DR. E. G. ALEXANDER reported a case of splenomegaly which he believed to be unusual both as to its size and for its long duration, without producing any marked constitutional symptoms.

He first saw the case on April 2 of this year in consultation with Dr. Peter P. Klopp, who had had the patient under his care since 1906.

The patient, a married woman, first consulted him in 1906 for an attack of diarrhoea, abdominal pain and vomiting. On examination he found the spleen enlarged to three or four times its natural size. The patient at that time gave a history of attacks of general itching of the skin, of dizziness, of rheumatic pains with swelling and redness of the joints, and occasionally of pains over the shafts of the tibiae. A blood examination at that time showed a count of about 7,000,000 red blood-cells. By 1913, the spleen had doubled in size, and about this time the patient had several severe attacks of abdominal pain, nausea and vomiting and dyspnoea. In November, 1915, the patient passed blood and mucus by bowel for about five days. In 1916, the patient had several attacks of dizziness, general itching of the skin and leucorrhœa.

For the past few years has had attacks of palpitation and distress in the cardiac region. The spleen has continued to increase in size, extending at present to the pelvis. Doctor Klopp had never been able to elicit a history of venereal disease from the patient or from her husband, but in 1915, her husband had an attack of iritis which was most persistent. A thorough course of anti-syphilitic treatment had failed to produce any appreciable effect on the size of the spleen. Doctor Klopp had frequently seen the patient when she was quite cyanosed.

On April 3, 1923, the patient was admitted to the Episcopal Hospital for study; the hospital history is as follows:

M. McL., aged fifty years, female, married, white. Maternal grandfather and grandmother died of old age. Father died of a sunstroke and mother died at the age of thirty-two years during childbirth. There is no history of tuberculosis, malignancy or splenic disease in the family.

The only sickness she ever remembers having was typhoid fever at the age of sixteen years. Menses established at the age of sixteen, always irregular and scanty; menopause at the age of forty-two years. No history of any injury. Married at the age of twenty-one years, two children, both instrumental deliveries; one child died in infancy and the other died at the age of nine years of diphtheria.

When seventeen years of age she first began having pain in the left side (splenic region). Has had pain in this region off and on ever since.

Seventeen years ago noticed a "lump" in the upper left quadrant of the abdomen about the size of a baseball, and since then the "lump" has been gradually getting larger until the present time. No great pain at the time of admission, only a pulling down feeling due to weight of tumor; some tenderness at times due to pressure of the clothes. Has had attacks of abdominal pain, especially confined to this region. For the past two years she has been getting cramps in the calves of both legs, quite



FIG. 1.—Mrs. M. McL., aged fifty years. Case of splenomegaly. Known duration, seventeen years. Dr. E. G. Alexander's case.

severe at times. Has had attacks of swelling and redness of her joints and some pain over the front of her legs. Six years ago had much itching of the skin, especially following bathing; this lasted for about two years. Does not think she has lost any weight. She has been unable to control her bowels for the last six years; is able to tell when she is going to have a movement, but cannot control them. Has indigestion and belches gas. Is quite nervous. The appetite is about normal. Has had night sweats. Never jaundiced. Has had attacks of shortness of breath and dizziness. About eight years ago had an attack of abdominal pain, which was accompanied by the passage of blood from the bowels; this condition lasted about a week.

Her abdomen was greatly distended, somewhat spherical in shape and had the appearance of a nine months' pregnancy; the swelling is slightly more prominent in the left half of the abdomen; no pulsations are visible. On palpation a distinct solid tumor can be felt. The mass fills the entire left abdomen and the right lower quadrant. The surface is smooth and the right margin can be easily outlined and a distinct notch is palpable about midway between the umbilicus and the xyphoid cartilage. The mass has the outline of a greatly enlarged spleen. (Fig. 1.) It is somewhat movable, and is slightly tender in certain areas on palpation. No pulsation palpable. Liver is not palpable and does not

seem to be enlarged. The patient complains of some pain over the abdomen on percussion. There is tympany in the right flank, but dullness and flatness over the remainder of the abdomen. There appears to be no ascites present.

The skin is dry, somewhat inelastic and appears to be scaly; there is no jaundice.

No oedema of the extremities; numerous brownish discolored areas over both legs. Pulse of moderate volume and tension.

The laboratory examinations were as follows: The urine was acid, light amber, specific gravity 1020, granular sediment, slight cloud of albumin, no sugar, epithelial cells, few leucocytes, 6 to 8 erythrocytes to H.P.F., urates, a few hyaline and granular casts, and bacteria present. The tests for bile and urobilin were slightly positive.

The phenolsulphonephthalein test for the first hour was 35 per cent., and the second hour 20 per cent. Urine urea 25.20 mm.

The blood showed erythrocytes, 3,950,000; leucocytes, 7,680; hemoglobin, 68 per cent.; polymorphonuclears, 84 per cent.; mononuclears, 4 per cent.; trans., 2 per cent; lymphocytes, 9 per cent; eosinophiles, 1 per cent; one nucleated red blood-cell per 100. Considerable variation in size and shape of reds. Coagulation time 8½ minutes. Blood urea 54.00 mm. Blood sugar 99.70 mm. per 100 c.c. Blood Wassermann positive plus 2. The erythrocytes showed an increased fragility and a diminished resistance. There was no evidence of malaria.

An examination of the feces showed a small amount of mucus, no ova or parasites present.

The X-ray examination by Doctor Bromer was as follows: "Chest showed moderate hilum thickening and peribronchial infiltration in both lungs, slightly greater than normal; this could easily be the result of some old infection; there is considerable enlargement of the heart shadow to the left." "The stomach is shoved far over to the right in the liver region; it has a flattened elongated appearance." "The duodenal cap lies almost on the right border of the abdominal cavity." "On the greater curvature are indentations which are felt to be in the same position as the splenic notch, of the large mass, evidently the spleen." "The 24-hour examination shows rather rapid movement of the meal; there is a slight amount of barium still to be seen in the hepatic flexure, which seems to be in about the normal position; the sigmoid and rectum also were filled and were not displaced."

During the patient's stay in the hospital she ran practically a normal temperature, pulse and respiration rate; she was bothered, however, with looseness of the bowels.

The patient refused to consider an operation and was discharged from the hospital April 21, 1923.

Of the known diseases which are accompanied by enlargement of the spleen, it seems that malaria, Hodgkin's disease, pernicious anemia, leukemia, hemolytic jaundice, Von Jaksch's disease, cysts, malignancy and trauma can all be excluded. This leaves splenic anemia or Banti's disease, Vaquez's disease, syphilis and Gaucher's disease as possibilities.

If the condition is one of Banti's disease, it must be in the first stage, but from the history given of so long a duration and the excessive size of the spleen, the evidence seems to be against that condition.

Is this a case of polycythemia vera? The 7,000,000 red count obtained by Doctor Klopp, seventeen years ago, with a history of cyanosis, would favor that disease; we now, however, have a secondary anemia, and this disease must be ruled out, although I am unable to say if the polycythemia in Vaquez's disease finally gives way and is supplanted by a secondary anemia. According to Moynihan, "Polycythemia begins in adult life in males and runs a progressive and fatal course, lasting a few years."

Syphilis of the spleen, of course, is a possibility; the only evidence we have of this disease is that of a plus 2 Wassermann.

Gaucher's disease does not wholly fit the case, although it comes nearer doing so than any of the other diseases mentioned.

The fact that he was dealing with a colossal spleen (and in Gaucher's disease we meet with the largest type of splenomegaly), that the patient is a woman, that it began in all probability in childhood, that there is no jaundice or ascites, and that the general health has been very little disturbed, even though the liver is not enlarged, he was inclined to believe it to be one of Gaucher's disease.

SEPTIC EMBOLI OF MESENTERIC ARTERIOLES

DR. E. L. ELIASON detailed the history of a man, aged twenty-seven years, who was admitted to the University of Pennsylvania Hospital, with diagnosis of acute appendicitis and peritonitis; operation performed same date, found perforated gangrenous appendix, with generalized abdominal congestion and cloudy fluid. Pelvic and local drainage established. Culture showed streptococci.

The post-operative course was stormy. For nine days the patient had recurring attacks of vomiting, passed but little or no fecus, was much distended and had very slight peristaltic action, and enemata were but slightly effectual. Ten days after operation a small abscess was evacuated through the original gridiron wound by digital exploration. No improvement followed. Peristalsis still markedly diminished. Patient was nourished by glucose and soda intravenously. Fifteen days from the original operation, audible and later visible peristalsis appeared and vomiting recurred. Enterostomy through left rectus incision was performed.

The patient improved greatly at once, and the enterostomy was very effective.

On the twenty-third day a left-sided parotitis developed (staphylococcus hæmolyticus) followed on the next day by a hemorrhage from the enterostomy, the blood appearing from the lumen of the proximal loop.

These hemorrhages continued for six days at intervals and resulted in death, despite blood transfusions.

Autopsy Protocol, Internal Inspection, Intestines.—The edges of the enterostomy wound are clean. In the neighborhood of the gall-bladder

there are a number of firm connective tissue bands which cause kinking of a loop of the small intestines. In the appendiceal region there is some matting together of small intestines to large intestine by recent exudate. a few drops of pus are present. The mesentery is normally fatty, and shows no gross changes. Intestines were removed and opened as usual. Enterostomy wound is present in the upper portion of the ileum. Beginning a few cm. above the wound and extending to the upper portion of the jejunum there are a number of ragged ulcerations, varying in size from several mm. to 2 cm. in diameter, situated usually at the line of mesenteric attachment, but occasionally found elsewhere and extending usually into the muscularis. About three dozen of such scattered ulcerations are found. These have not perforated, but their base is generally bloody. Dissection made to find any obstructed blood-vessels, but no evidence found that such exist. The lumen of the small intestines contains a considerable quantity of clotted blood, possibly 1500 c.c. of blood being present in the ileum. Below the enterostomy there is a superficial ulcer 15 mm. in diameter, round in shape and with clean-cut edges. This is said to be at the site of a rubber tube which had been pushed into the intestine through the surgical opening. No ulcerations such as have been described above are present. Below the enterostomy wound a large quantity of clotted blood is found, both in the small and the large intestines. The stump of the appendix and the immediate neighborhood are covered with a few drops of pus and some partially organized fibrinous exudate. The intestinal serosa otherwise is smooth, moist and glistening and nowhere coated with exudate.

Sections were prepared and examined histologically from the following parts: (1) small intestines, (2) liver, (3) spleen, (4) kidney.

Small Intestines.—Section is probably from the upper part of the ileum. At one portion there is a deep ulceration which extends well into the muscularis. The ulcer commences abruptly, its bed consists of a mass of necrotic tissue in which there are numerous plasma cells, polymorphonuclear leucocytes and occasional small round cells. Similar cellular material is present between the loosely arranged muscle fibres and between the gland tubules on either side of the ulceration. The serosa is stripped off, but there is here a moderate infiltration of similar character as the one described; the predominating cell is the plasma cell. There are no tubercles, nor areas of necrosis, such as are produced by the tubercle bacilli. The capillaries in the bed of the ulcer are moderately engorged, only small arterioles and venules are included in the section, and these possess normal walls and normal contents.

In the opinion of the pathologist the multiple ulcerations are due to embolic occlusion of small branches of the mesenteric arteries possibly by septic emboli following the infection of the appendiceal site.

REMOVAL OF FOREIGN BODY FROM THE LUNG

DR. D. L. DESPARD presented a man who had been referred to Dr. Chevalier Jackson by Doctor Gibbons at the Jefferson Hospital for the relief of a wound of the thorax caused by a premature blast which had driven a piece of coal through a wound of the left chest wall in June.

1921. The wound healed except for several sinuses which persisted, and three unsuccessful operations were done in the hope of removing the cause of their persistence.

An X-ray examination revealed a foreign body within the thorax lying near the anterior axillary line. On account of the great thickness of his chest a satisfactory picture was not obtainable.

At the operation April 4, 1923, the scar tissue of the previous operation was removed together with fragments of reformed ribs. There was a great deal of hemorrhage during this part of the operation, but very little after the thorax was entered, the lung being fibrous and bleeding very little.

By following the sinuses he was finally able to detect the foreign body with a probe. Following the probe with incision enabled me to enter the cavity in which the lump of coal was imbedded, and to deliver it. The coal proved to be about an inch long by about three-quarters of an inch thick.

As the patient had expectorated shreds of cloth at times, a careful digital exploration was made to detect if possible anything else within the chest of this nature, without locating anything. The finger when turned forward came in direct contact with the pericardium at about an inch above and behind the apex.

The patient expectorated a small amount of bloody mucus, but there was no distinct communication with a bronchus. The lung cavity was packed with iodoform gauze and the patient returned to his bed.

Five days later he removed the gauze and asked Doctor Clerf to explore the cavity with a bronchoscope through the chest wall. Upon doing so a small black spot was detected hardly larger than the head of a pin, which proved to be the end of a piece of cloth about an inch long by one-quarter of an inch in diameter and apparently plugging the lumen of a bronchus, as upon its removal there was very free movement of air in and out with each expiration.

The cavity was again packed with iodoform gauze, which was changed every day or so as the case progressed, and he was inclined to believe the use of this gauze may have been a factor, by stimulating granulation, in the rapidity with which the bronchus closed and the wound healed.

The patient's general condition is satisfactory and the wound has almost healed.

A PLAN OF MANAGEMENT OF CRANIAL INJURIES *

DRS. J. S. RODMAN and B. B. NEUBAUER said that much confusion has arisen concerning the terms concussion, contusion, and compression of the brain. When, as is so often the case, these conditions are complicated by other conditions such as intracranial hemorrhage there is still greater difficulty. It is frequently difficult, therefore, to draw a clear mental picture of the underlying pathology of these conditions and hence to decide which cases fall under these various clinical headings. It follows that without a "clear-cut" under

* The following is offered at this time as a preliminary report on a plan now in effect at the Presbyterian Hospital, Philadelphia.

standing of the pathology and, therefore, of these clinical conditions themselves, it is impossible to lay down adequate regulations for treatment. It was with the idea of attempting to clarify this atmosphere in their own minds that led them to discard the terms of concussion, contusion and compression for practical use. The grouping of brain injuries which they suggest in their place has at least the advantage of simplicity, a much needed factor in any attempt to substitute one classification for another in regard to these injuries. In fact classifications of disease or traumatic conditions in general have no value unless on the basis of such a classification a rational treatment can be built. This essential they believe is met in the grouping they propose.

In dealing with intracranial lesions, acute or chronic, caused by disease or trauma a most important factor to take into consideration is *intracranial pressure or tension*. In most of the chronic lesions, as brain tumors, intracranial tension is given the importance due, but such is not the case in acute brain injuries. It is their belief that acute intracranial tension is just as important as chronic intracranial tension. Much has been written of acute brain injury and we do not propose to quote from this extensive literature. But while acute intracranial tension is often referred to notably by Jackson¹ and Sharp² it seems that to few it is the one condition which means life or death to the patient. It has come to be their belief that this is so irrespective of whether we label these cases concussion, contusion, or compression. Fortunately, intracranial tension can be estimated by clinical as well as by a more exact means, namely the spinal manometer. Furthermore, each of these groups have definite indications for treatment based entirely on the presence or absence of increased intracranial tension. On this basis they now classify all cases of brain injury as follows:

Group No. 1. No increase in intracranial tension.

Group No. 2. Moderate increase in intracranial tension.

Group No. 3. Marked increase in intracranial tension.

In order to determine which of these groups the patient falls into the following observations can now be made, after the stage of surgical shock has been passed:

A. General examination including neurological findings.

B. Observation of the temperature pulse, respiration and blood-pressure every four hours.

C. X ray of skull.

D. Spinal puncture, being careful to estimate pressure by means of the spinal manometer. As a result of examination the following types of cases will readily fall into one of these groups. Some will, of course, pass in progressive stages from one group to another.

Into Group No. 1 (no increase in intracranial tension) those cases will fall showing abnormal spinal pressure of 8 to 10 mm. of hæmoglobin and a normal or slightly elevated blood-pressure. To these essential findings may be added the less important ones of a normal or slightly elevated temperature, pulse

and respiration, primary unconsciousness either momentary or at most lasting for several minutes, followed by headache and dizziness. Normal eye grounds. The treatment of this group is, of course, non-operative and consists of A. Rest in bed (4 to 5 days). B. Ice-cap to head. C. Sedatives as needed.

These cases of Group No. 1 always recover unless some complication arises.

In Group No. 2 (moderate increase in intracranial tension) those cases will fall showing a spinal pressure from 10 to 18 mm. of hæmoglobin moderate rise in blood-pressure, moderate rise of temperature and pulse rate, and a normal respiratory rate. These cases may show the primary unconsciousness followed by dazing and headache mentioned above. To these mental symptoms may be added mild confusion or delirium after the period of unconsciousness has passed. The eye-grounds will show a congestion of the retinal veins. The indications for treatment in this group are again non-operative and will consist of: A. Rest in bed. B. Ice-cap to head. C. Elevation of head of bed. D. Therapeutic spinal puncture (5 to 10 c.c. of spinal fluid may be removed as often as necessary usually every 24 hours for several days or as much as is needed to reduce the reading of the spinal manometer to 8 to 10 mm. of hæmoglobin.

E. Intravenous injection of hypertonic saline (60 to 80 c.c. of a 15 per cent. solution) or magnesium sulphate by mouth. Because of the ease with which magnesium sulphate may be given this is perhaps more practical than the intravenous injections of hypertonic saline although the latter solution is quicker in its effect, and in the majority of the cases of this group it is only necessary to give one injection.

The majority of the cases of this group will get well unless some complication arises.

They believe that approximately 70 per cent. of all cases with brain injury will fall into one or the other of these two groups.

Into Group No. 3 (marked increase in intracranial tension) will fall into those cases showing a spinal pressure above 18 mm. of hæmoglobin an increased blood-pressure which will fall as this stage progresses. (Pulse pressure is much more valuable than systolic or diastolic readings; when the pulse pressure equals the pulse rate a good single indication for operative relief of tension exists). These cases will show a normal or slightly elevated temperature until the final stage (medullary œdema) when hyperpyrexia is present. The pulse rate will gradually become slower as well as full and bounding until it becomes subnormal as pressure advances until medullary œdema is present and then in this closing stage will again become rapid and weak. There will be stupor increasing to coma. The eye-grounds will show congestion of the retinal veins and uncommonly paling of the optic disk. (We believe that true choked disk does not occur in an acutely increased intracranial tension), but optic atrophy may develop later.

This group they believe calls for operative relief of tension in addition to

A PLAN OF MANAGEMENT OF CRANIAL INJURIES

the measures outlined in the preceding two groups. It is their practice to perform a subtemporal decompression on the right side usually with drainage and at times a bilateral subtemporal decompression.

They submit this classification of brain injuries with its indications for treatment for what it may be worth and as a preliminary report of their present views on this subject. These views are based on experience gained in the handling of such injuries largely at the Presbyterian Hospital in this city, as well as by one of them during the war. They have purposely omitted from this discussion such frequent complications of brain injuries as scalp wounds, fractures of the skull, intracranial hemorrhage, penetration of foreign bodies and localizing pressure on the brain from any cause, believing that these complications are operative indications in themselves, and that the operative management of these complications has now been well standardized in general. In closing they repeated their belief that it is intracranial tension caused by œdema which plays the important rôle in acute brain injury as it does so often in chronic brain lesions.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held May 9, 1923

The President, DR. EUGENE H. POOL, in the Chair

DIVERTICULUM OF BLADDER

DR. HERMANN FISCHER presented a man, seventy-one years of age, who was admitted to hospital with complete retention of urine, from which he had been suffering for two weeks, obtaining relief during this time only by catheter. The passing of the catheter through the urethra was easy. Per rectum could be felt an indistinct soft mass just above the prostate, and pressure upon it with the tip of the finger caused a gush of thick pus to escape through the catheter. The mass had disappeared and the patient was able to urinate spontaneously.

The bladder was opened by an epicystotomy and a diverticle was found at the base of the bladder, to the left and to the front of the left ureter. The opening was round, about the size of a quarter. It was rather large as the examining finger could not reach its bottom. A circular incision was carried around the opening cutting through the wall of the bladder, care being taken not to injure the left ureter. The diverticle was then packed with a gauze tampon, its edges secured by several clamps and it was then shelled out from the perivesicular pelvic tissue by a blunt dissection without great difficulty. The large extravascular cavity left after the removal of the diverticulum was tamponed, the tampon being led out along the lateral wall of the bladder. The wound of the bladder was entirely closed by two rows of sutures and the bladder drained by tube through the epicystotomy wound. The tampon was removed on the fourth day after operation. The patient made a good recovery and was out of bed after two weeks. There was, however, some delay in the healing of the suprapubic wound which would alternately open and close for several months. He passed urine in a normal stream and without difficulty and pain. The patient would have considered himself well had it not been for the little leakage off and on from the suprapubic wound. He was readmitted three months after the operation. Cystoscopy showed a moderate cystitis with a slight prostatic hypertrophy. At the seat of the former mouth of the diverticulum there is a smooth white linear scar of the mucous membrane. Insertion of an indwelling catheter. This was well borne by the patient, and after two weeks the suprapubic wound had closed and the patient could be discharged cured.

There was never any leakage of urine along the tampon, as the bladder wound healed by primary union. This diverticulum was

ACUTE PERFORATION OF STOMACH

so-called spurious or false diverticulum, its walls consisting of only mucous membrane, no muscular fibres being present. Several years ago he observed a case of an old man with prostatic hypertrophy, who also had a huge congenital diverticulum, which was larger than the bladder, and which was situated at its vertex. In this case only drainage was employed.

DR. CHARLES L. GIBSON said that in a similar case he had used a mild procedure tentatively with satisfactory results. All he did was to burn away the diaphragmatic opening and, although the patient has a slight cystitis, he has gotten along as well as if a more radical operation had been done.

ACUTE PERFORATION OF THE STOMACH

DR. CHARLES L. GIBSON presented a man, aged twenty-eight years, who was admitted to the New York Hospital, March 29, 1923, with the history that he had had some mild gastric manifestations about two weeks before present illness. One hour ago patient developed sudden sharp pain in the right upper abdomen which caused him to collapse. Shortly afterwards marked pain appeared in the region of the lower cervical spine; but did not persist.

Examination showed patient moderately developed and nourished, in great pain and moderate shock. There was no obliteration of the liver dullness. Board-like rigidity and great tenderness of whole upper abdomen.

Fluoroscopic examination and X-ray plate showed a distinct layer of air under the diaphragm on the right side, possibly also less clearly on the left side.

Immediate operation was done after prior ingestion of methylene blue. Peritoneum opened under water. Much gas and presence of methylene blue in the abundant rosy fluid. Perforation three-eighths of an inch in diameter on gastric side of pylorus. Patient made a good recovery with a slight superficial infection of the wound. Discharged April 12, 1923.

DOCTOR GIBSON said that he presented this case because it presents all the possible diagnostic points: 1. Previous gastric history. 2. Sudden onset with collapse and typical abdominal findings. 3. Secondary or referred pain—a very characteristic, diagnostic feature generally in the supraclavicular fossa, usually the left. This secondary pain comes shortly after the original pain and usually does not last very long. It is apt to be forgotten by the patient and is not usually mentioned in books. 4. The presence of air, free in the abdominal cavity as demonstrated by fluoroscopy and X-ray picture. 5. The absence of the sign designated as "obliteration of liver dullness." Never seen by him in any perforation of gastro-intestinal tract. 6. The presence of air free in the abdominal cavity when the peritoneum is opened between two clamps, wound being flooded with water. The exit of air under these conditions is absolute proof of a perforation of the gastro-intestinal tract. On the other hand, a perforation may exist without this sign being present. 7. The presence of methylene blue in the abdominal contents.

ACUTE PERFORATION OF STOMACH WITH TRANSPOSITION OF VISCERA

DOCTOR GIBSON presented a man, aged forty-one years, who was admitted to the New York Hospital April 16, 1923.

For two or three days he suffered an exacerbation of long standing gastric disturbance. Two hours before admission sudden, very severe, cramp-like pain in epigastrium. Brought to hospital in ambulance.

He was a large, well developed man, in great pain and moderate shock. The abdomen is retracted, board-like, and the maximum of pain

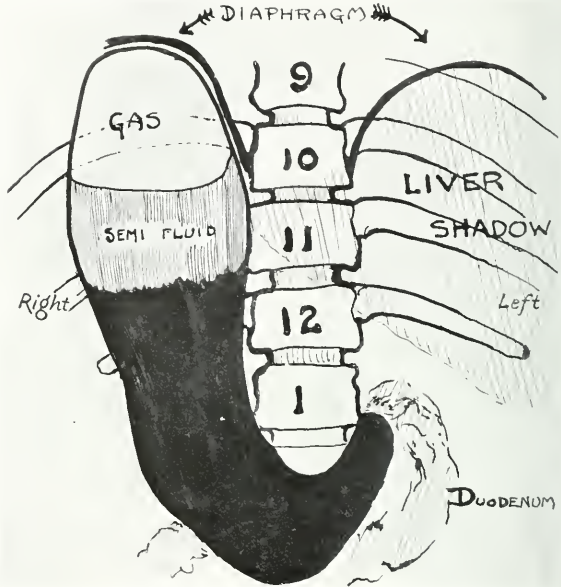


FIG. 1.—Transposition of viscera and perforated ulcer. (Diagram kindly furnished by Dr. Clay Ray Murray, Deputy Assistant Surgeon, New York Hospital.)

tenderness and rigidity are just above the umbilicus. There is no obliteration of the liver dulness.

Fluoroscopy to detect air under the diaphragm shows that the patient has a transposition of viscera (Fig. 1), so the operation is planned to expose the pylorus by an incision to the outer border of the *left* rectus muscle.

Immediate operation after administration of methylene blue. Peritoneum opened under water. No gas. Opening in peritoneum is sealed by adherent omentum. Mucilaginous, bluish colored fluid is seen coming from under left costal arch. Perforation is found on upper

PARTIAL COLECTOMY FOR MEGACOLON

surface, just para-pyloric. It is three-quarters of an inch in diameter, indurated base size of twenty-five cent piece. Easily closed with double chromic gut sutures.

Uneventful recovery, discharged sixteen days after operation.

NOTE: It is possible that this is the first instance of a pre-operative diagnosis of this condition. Summers, Nebraska State Medical Journal, April, 1923, says: "In abdominal surgery I do not know of an instance which has been recorded in which a transposition of the abdominal viscera had been diagnosed before the abdomen was opened."

DR. JOHN DOUGLAS said as to reference of the pain to the upper clavicular region in these cases of acute perforation of the stomach, he had never had any of his own patients complain of such pain, but had never questioned them thereon. As to the loss of liver dulness, he thought this depended on the amount of gas escaping from the perforation, and he did not see why, if the patient is propped up, some of that gas should not rise to the upper part of the abdomen, and if the falciform ligament were sufficiently lax, obliterate the liver dulness. Although this symptom is not present in all cases, he felt very sure that it had been present in several of his cases of perforation. As to gas under the dome of the diaphragm, he had never had an opportunity to see that by fluoroscopic examination, but within the last six or eight months he had one case of perforation which occurred within four hours of the time of taking bismuth for an X-ray picture. There was no evidence from the X-ray from which a diagnosis of perforation could be made; there was no air under the diaphragm although some of the bismuth had leaked out of the perforation of the duodenum and a portion of it had gravitated down along the under surface of the left lobe of the liver.

PARTIAL COLECTOMY FOR MEGACOLON

DR. R. W. BOLLING presented a boy, now fourteen years of age, who first came under observation two years ago when he was admitted to the Medical Service at St. Luke's Hospital. There was a history of constipation since birth, abdominal distention and, in recent years, frequent attacks of intermittent abdominal pain.

The immediate cause of admission was severe abdominal pain and distention unrelieved by cathartics or enemata. He was found to have a large fecal impaction, which was removed, and under medical treatment his symptoms were relieved and he was discharged eighteen days after admission.

At this time a bismuth injection showed a greatly dilated and redundant sigmoid colon and rectum. He remained well for about one month, when the symptoms recurred, again yielding to medical treatment carried out at home. From this time until one year ago he suffered at intervals. One year ago he was readmitted to the medical service at St. Luke's in a condition similar to that on his previous admission, and he was eventually referred to Surgical Division A and assigned to Doctor Bolling for treatment.

At this time a bismuth injection confirmed the previous findings with possibly a greater dilatation of the sigmoid colon (Fig. 2). In July, 1922, he was operated on. Two feet of the large intestine, including the



FIG. 2.—Megacolon. Bismuth injection before operation.

sigmoid, were resected, the descending colon being united to the recto-sigmoid by means of a lateral anastomosis. At operation the sigmoid colon and rectum were found to be greatly dilated and the walls thickened. The remainder of the intestine appeared somewhat dilated but relatively normal. After completing the anastomosis a tube was carried from the anus through the stoma into the splenic flexure.

PARTIAL COLECTOMY FOR MEGACOLON

The post-operative course was uneventful and the wound healed by primary union, the small rubber dam drain being carried out through a stab wound. The boy was discharged from the hospital nineteen days



FIG. 3.—Partial colectomy for megacolon. Bismuth injection eight months after operation. The bismuth was completely eliminated in twenty minutes.

after operation. Since discharge he has had no symptoms, has not missed a day at school and has gained 22 pounds in weight. His bowels are usually regular, but sometimes he goes three days without a movement, apparently from lack of inclination to evacuate his bowels. A bismuth injection (Fig. 3) was completely eliminated in twenty minutes.

It is difficult to say whether such a condition is congenital or acquired.

Possibly there is a congenital defect in the innervation of the lower bowel tending to fecal impaction which resulted in dilatation and hypertrophy of the large intestine above. Certainly such patients afford quite a problem, and operation is not to be undertaken lightly. The home conditions of this patient were investigated and operation decided on only when it was evident that the usual palliative measures to prevent future attacks could not be regularly carried out. The operation performed was in a sense only palliative as an abnormal rectum remains, and the development of this boy will be followed with great interest.

DR. LEON T. LEWALD said that the problem that presented itself in the cases of megacolon was the functioning of the colon. Although in this case a large segment of the colon has been resected and there is still some dilatation, the function is perfectly good, while prior to operation it was decidedly pathological.

Röntgen examination not only makes or confirms the diagnosis in this condition, but by means of a very careful study will frequently reveal the fact that the dilatation does not involve the entire colon. It may, for example, involve only the descending colon and sigmoid flexure. In other cases the dilatation may involve separate portions of the colon, such as the hepatic flexure, splenic or sigmoid flexure, or all three of these regions. Or there may be a combination of dilatation of the lower portion of the large bowel associated with marked redundancy of the sigmoid flexure. At the time Hirschsprung described the condition which is known by his name he had no opportunity to examine radiographically the different types of dilated colon. Inasmuch as there are hardly two cases alike it becomes all the more necessary to examine a particular case radiographically with extreme care, both by means of an opaque meal and an opaque injection.

ACUTE INTUSSUSCEPTION IN INFANTS

DR. RICHARD W. BOLLING read a paper with the above title, for which see *ANNALS OF SURGERY*, vol. lxxviii, p. 349, 1923.

DR. CHARLES E. FARR said that of about thirty cases of intussusception which had been under his care two were adults, one with carcinoma and the other sarcoma of the bowel, and several were older children. He agreed with almost everything Doctor Bolling said, and particularly with the statement that these infants look to be in good condition. They are not shocked for perhaps twenty-four hours, but they do not stand operation very well after two or three days. As to the nomenclature, he would designate the condition as enteric or colonic intussusception. As to the use of the X-ray, he had found this extremely valuable and has found an intussusception under the fluoroscope. There are other conditions that give blood in the stool and make the differential diagnosis difficult, but these children are not obstructed in any way. He had one case of appendicitis with intestinal symptoms that would make one think of intussusception. As to treatment, operation is the only thing, and the hydrostatic method in combination is of some help.

DR. ROBERT T. MORRIS, speaking of the etiology, said that intussusception is probably an expression of several causes, and one of these may be an elective affinity of the region for certain toxins, resulting in spasm of the circular fibres. The spastic area is then engulfed by peristaltic progression. The experiment may be made by touching a rabbit's bowel with a trifle of carbonate of sodium. He believed that in the cases where there was gangrene and the patient is in desperate condition one should not do good surgery; split the intussusception open quickly, take a suture on either side to the abdominal wall, and let the child live. Later, complete the operation. He has had an intussusception recur while looking at it, but taking a stitch through the bowel wall above and below the involved area and hitching these points to the abdominal wall solved the problem.

DR. EDWARD W. PETERSON had reported about a year ago forty-six cases of intussusception in infants and children and has had two cases since then. He has not resorted to the X-ray for diagnosis in any of his cases, although he believes it to be a valuable measure. He quoted from his report as to the etiology of the disease and also as to results, in his series of cases. In two cases, in boys four and one-half and seven years, respectively, a Meckel's diverticulum was the causative factor in the production of the intussusception. In another case, a six and one-half months' old male infant, a congenital tumor of the cæcum (cystadenoma) was the cause. In another infant, the last two inches of ileum, not involved in an ileocecal intussusception, appeared macroscopically to be the seat of a papillary angiomatous growth. The pathologist, however, pronounced the growth to be merely inflammatory. Appendicitis is believed to have been the causative factor in several instances. It has been his rule to make the removal of the appendix a step in the operation, believing that occasionally appendicular irritation induced the spasm and brought about the invagination. Since the histological study of these appendices has been taken up as a routine measure, it has been found that a certain number of them show definite, acute inflammation, even where no trauma to this organ was present. Enlarged mesenteric glands were found in a considerable proportion of these cases, but were thought to be the result rather than the cause of the trouble. In the majority of the cases, no unmistakable causative factor was found to account for the intussusception.

As to results, one infant who had been ill for seven days with intussusception was moribund when brought to the hospital and died within an hour of admission. Another late case, ill for three days, died on the operating table just as the operation was started. A gangrenous, irreducible, double intussusception was removed post-mortem. There was but one successful reduction without resort to laparotomy. The patient, a girl five years of age, was seen in consultation with Dr. A. H. Cilley and presented the usual history and symptoms of intussusception. Following hydrostatic pressure and postural treatment, relief was obtained. Of the remaining 45 cases, 30 were reducible and 15 were either gangrenous or irreducible or both. In the first group there

were 3 deaths, due to an overwhelming toxæmia, 9 hours, 7 hours, and 5 hours after reduction in infants who had been ill 4 days, 3 days, and 3 days respectively. Another fatality occurred in a boy who developed a colic intussusception while ill with influenza, during the 1918 epidemic. Reduction was accomplished with ease about 6 hours after the onset, but death followed 4 days later and was due to a double influenza pneumonia. Another case developed pneumonia after leaving the hospital and died of this disease on the fourteenth day following operation. Another late death occurred in a four-months-old infant 21 days following operation, after dismissal from the hospital. In this instance the cause of death was not determined. To sum up the results in the reduction cases: There were 24 cures and 6 deaths, mortality 20 per cent. If allowed to exclude the deaths not directly due to the intestinal obstruction or to the surgical treatment thereof, the mortality would drop to 10 per cent. There were several recoveries in late and profoundly toxic cases. The longest interval between the onset of the disease and a successful reduction was 4 days; the shortest was 5 hours. Every case in this group seen within 48 hours of the onset recovered, with the single exception of the boy who died of influenza pneumonia. In the second group of 15 cases requiring resection there were 4 recoveries and 11 deaths; mortality 72.4 per cent. Of the thousands of cases of intussusception which have been reported throughout the world, there are on record less than a score of successful resections in infants. In older children the statistics are not quite so appalling. In 1905, the speaker had presented before the Surgical Section of the Academy of Medicine the first successful resection of a gangrenous intussusception in an infant on record. Since that time he has had two other successful resections, one in an infant eight months old and the third in a boy four and one-half years old. The fourth successful operation in this series was performed by Doctor Silleck. Of the 11 fatal cases, 9 were in infants.

DR. WINFIELD SCOTT SCHLEY referred to Doctor Peterson's case of recovery after gangrenous intussusception as being the first on record. His own case, shown before the Section on Surgery of the Academy of Medicine a year or so later and published in St. Luke's Annual Report for 1910, was the second case on record. Doctor Peterson's case recovered after being operated on four days after the onset of the symptoms. Doctor Schley's patient, a girl six years of age, recovered after being operated on six days after the onset of the symptoms. These cases were both rare, and interesting in that they recovered after so severe a pathology.

DR. THEODORE DUNHAM spoke of a child he had operated on where the intussusception was in the small intestine. Manual reduction was difficult, but successful. Just as the final disengagement of the intussusception was accomplished, the patient ceased breathing, the pupils fully dilated and, for a short time, the situation was alarming. Under restorative measures the child began to breathe and complete recovery was uneventful. Doctor Dunham said he spoke of the case as an instance of the shock which might be involved in reduction.

DR. CHARLES GORDON HEYD said that he had made it a rule to remove the appendix and had never seen any bad results following this procedure. The clinical condition was absolutely clear cut and distinct, and it is an interesting fact that the internes at the hospital uniformly make the diagnosis but that the practitioners on the outside delay in making the diagnosis and the patients reach the hospital in an extremely desperate condition. Doctor Heyd was in accord with Doctor Bolling as to the necessity of very careful suturing of the abdominal wall, as he had two recent cases where a hernia had developed in the incision. It has been Doctor Heyd's experience that the intussusception reduces itself easily or it does not, and one should make two or three attempts at reduction and then make the decision to resect rather than to continuously attempt reduction, for it was his experience that if reduction did not occur readily it was doubtful if it would be brought about by persistent manipulation. As to mortality, the most frequent cause of Doctor Heyd's mortality was not the surgery but the pneumonia and the ileal colitis that developed as complications many days after the laparotomy. He did not consider there was any place for aero-hydrostatic procedures in the reduction of an intussusception but that it demanded a laparotomy the moment the diagnosis was made.

DOCTOR BOLLING in closing the discussion said in reference to removal of the appendix, that early in his experience with intussusception his attention was directed to two cases where appendectomy was carried out in the course of operation for the reduction of early intussusception. Both of these infants died from peritonitis, and the autopsy revealed leakage from the appendix stump. Naturally this prejudiced him against routine appendectomy, and as he has operated on more and more of these cases, he has been impressed with the fact that it is an unnecessary detail.

An obviously gangrenous appendix or an inverted appendix should of course be removed. If the appendix is at all involved in the intussusception it would naturally show inflammatory changes, which he did not think could point to the appendix being the cause of the intussusception.

BOOK REVIEWS

DISEASES OF THE RECTUM, ANUS AND COLON. By SAMUEL G. GANT, M.D., LL.D. Three volumes. Philadelphia. W. B. Saunders Co., 1923.

The author has attempted to present a treatise upon the entire subject of diseases of the rectum, colon and anus covering the history, etiology, pathology, symptoms, diagnosis, treatment and post-operative management of pathologic conditions affecting this portion of the alimentary tract. For convenience the work has been separated into three volumes. The first two dealing with the rectum and anus and the third with the colon and ileocolic angle.

All of the subject matter is attractively arranged and profusely illustrated as evidenced by the 1128 cuts and many colored inserts, the great majority illustrating the author's personal procedures, and showing the mechanical ingenuity of the writer and his ability to devise instruments and appliances to meet the various needs of an operator on these conditions.

This tends to lend a monographic representation to the work as a whole, and it is noted especially that little if any credit is given other innovators where their methods are mentioned, and further that slight or insignificant modifications of classical operations are given a caption of "author's technic." This continued, unnecessary and repeated reiteration, the reviewer feels tends to detract from the general excellent exposition of the subjects (refer to vol. xi, Figs. 637-639-642 *ad infinitum*, are methods universally employed and illustrate the objection raised).

Dogmatic statement of superior results obtained by the author's methods and belittlement of contemporary surgeons' efforts by other means which are more generally recognized is a further criticism. One illustration of which will suffice, ref. vol. xi, pp. 53-54, Figs. 405-406, "*Author's excision*." This operation was done many years before the author practised medicine and has either now been superseded by that of Moschcowitz (three lines on page 56 being accorded this important reference), or is utilized in conjunction with it.

The author's confusion of terminology is also noted, ref. vol. i, Chapter XVI, p. 260, here the terms "proctitis" and "rectitis" are used interchangeably, in fact the first paragraph begins with "Proctitis" and the second with "Rectitis." These observations are of course unessential, but do not lend themselves to the generally excellent presentation of the subject which represents observations and results based on a large experience such as may be acquired in a metropolitan hospital.

The work will undoubtedly prove of great value to the reader not experienced in the latest procedures in these intricate problems. Certainly it represents the most ambitious and complete consideration of diseases of the lower intestinal tract as yet published in the United States.

JAMES T. PILCHER.

BOOK REVIEWS

DISEASES OF THE EAR, NOSE AND THROAT, MEDICAL AND SURGICAL. By WENDELL CHRISTOPHER PHILLIPS, M.D., Professor of Otology, New York Post-Graduate Medical School and Hospital. Sixth Revised Edition. Philadelphia, F. A. Davis Company, Publishers, 1922.

Thirty-four more pages and thirty-three more engravings are contained in the present (sixth) edition than were found in the first, printed eleven years ago. Thus Doctor Phillips and his publishers are making good in their intention to keep this work up to the minute and to incorporate all that is really gain and progress in the science of otology, rhinology and laryngology.

The previous and more extensive reviews of this excellent and standard work which have previously appeared here and in the pages of other current periodicals make it unnecessary to again rehearse its merits, other than to give an abbreviated summary of contents, as follows: The specialist's office equipment, methods of examination of patients, physiology of the hearing apparatus, and the general etiology, symptomology, diagnosis and therapy of ear diseases; the surgical anatomy, diseases, malformations, anomalies and neoplasms of the external ear; diseases and injuries of the drum membrane, the anatomy, classification and diseases of the middle ear, the simple and radical mastoid operations, purulent labyrinthitis, lateral sinus thrombosis, meningitis and otitis brain abscess; otosclerosis and diseases of the auditory nerve, the influence and effects of tuberculosis, lupus, syphilis, diphtheria, scarlatina, measles, typhoid and typhus upon the ear, nose and throat; inflammations and injuries of the nasal mucosa, the nasal accessory sinuses, the nasal septum, and also the details of their correction, and the occurrence of epistaxis, foreign bodies, neuroses and neoplasms; the special fields of the pharynx, fauces and larynx are likewise covered with equal attention, and a complete description of the modern method of removal of the larynx and of suspension laryngoscopy are here given in addition to the matter found in previous editions.

WILLIAM C. BRAISLIN.

CORRESPONDENCE

GASTRO-COLIC FISTULA

EDITOR, ANNALS OF SURGERY:

Sir:

In the April number of the last volume of ANNALS OF SURGERY (vol. lxxvii), Dr. George P. Pratt contributed an interesting review of cases of gastro-colic fistula, with a report of a case operated on by him. As this condition occurs often enough to be of diagnostic and surgical interest, but as the number of cases in the literature is still extremely limited, I am prompted to submit to you the following case report:

Mrs. E. F. K., housewife, age forty-six, married twenty-four years. The family history was negative. She had the usual diseases of childhood, as well as yellow fever, and bronchial pneumonia at thirty-two. Her menstrual history was without incident, the menopause occurring abruptly in January, 1919, in the course of the illness described below. She had had four full term, normal deliveries, and one miscarriage. She had been constipated all her life but her digestion was excellent. Her average weight was 112, and her general health always good, though she had never considered herself robust.

Her present illness began seven years before operation, with continuous dull pain in the epigastrium, radiating to the back, and occasional acute pains, most marked in the back. There were gaseous eructations and general digestive discomfort, with increased constipation, but no acute illness and no nausea or vomiting. The kind of food she ate did not influence the condition. In the spring of 1918, she suddenly lost her appetite and for nearly a year ate practically nothing. Six months later she began to vomit undigested food at intervals, and she noticed that her breath was extremely foul. Ordinary remedies were tried without avail, and by January, 1919, her condition had become grave. She was forced to remain in bed and there was practically continuous vomiting, the food returning undigested from several hours to two or three days after ingestion. She had a constant sense of fullness in the epigastrium, a feeling of "being packed," as she described it. At intervals she vomited liquid brown material of very foul odor, and for six weeks in the spring of this year she had greenish-black stools, also of very foul odor. Shortly afterwards her appetite became enormous and she ate quantities of solid food at frequent intervals, followed by intense vomiting spells as described above. As there had been no relief from the various measures tried she became discouraged and for three months tried Christian Science and homœopathy, of course without results. During this period she had two attacks of excruciating pain in the right lower abdomen; she had also a constant sensation of numbness in her hands and feet, and she lost her sense of touch entirely. Her weight had dropped to 78 pounds. Her teeth had been investigated and several extracted with no benefit.

When I first saw her early in October she was extremely emaciated and complained constantly of epigastric pain. There was some contraction of the muscles of both legs and of the extensor muscles of the hands. A palpable mass could be outlined in the upper right quadrant, corresponding with the location of the pylorus. The X-ray examination showed some pyloric obstruction, with

a marked gastric retention at six hours, and we thought the condition unquestionably malignant. Careful treatment for three weeks improved her general condition considerably, and made an exploratory operation a reasonably safe procedure.

Laparotomy was accordingly done under ether anesthesia, October 27. The cæcum and ascending colon were enormously dilated and the walls greatly thickened owing to a partial obstruction at one point in the transverse colon where it was attached to a mass apparently springing from the pylorus. This mass was fully three inches in diameter and was densely adherent to the liver and surrounding structures. After the colon had been separated from the pyloric mass an opening was revealed between the stomach and the bowel, evidently of long duration. The intestine was sutured by the usual technic, and the pylorus, together with three inches of the stomach, was resected according to the Billroth technic, and a posterior no loop gastro-enterostomy was performed. The stomach and duodenal ends were closed with no attempt at anastomosis.

The patient stood the operation well, and although she was critically ill for several days she finally began to improve, and was discharged from the hospital on the twenty-seventh day. She had been nourishing well and was gaining in strength, although she was still extremely weak. She remained in bed until the end of December, then gradually began to resume her usual mode of life, and at the end of six months was practically normal. Since the operation she has had no digestive symptoms of any sort, her diet is unrestricted, and she weighs 111 pounds. She is very active and regards herself as perfectly well.

The pathologist reported the specimen a perforated pyloric ulcer.

C. JEFF MILLER, M.D.,

New Orleans, La.

A GRIDIRON AND A HALF-GRIDIRON INCISION IN OPERATIONS ON THE BILIARY TRACT

EDITOR ANNALS OF SURGERY:

Sir:

THERE is a group of cases requiring exploration of the biliary tract in which the abdominal wall is relaxed and the transversalis muscle is thinned and weakened. The usual approach by a high incision, separating the fibres of the right rectus, cuts the transversalis across its fibres. A transverse incision, more or less parallel to the ribs, cuts the rectus fibres and splits the transversalis. I have found it useful in somewhat relaxed abdominal walls to split both the fibres of the rectus and the transversalis making a gridiron incision.

The patient is placed on an operating table so constructed as to break in the middle. A sand bag is set directly over the break in the table and the patient so placed that the ensiform cartilage is also directly over the break.

An S-curved incision is begun at the very tip of the ensiform cartilage and is carried liberally downward to a point two inches above and two inches to the right of the umbilicus. The sheath of the rectus and the muscle itself are split longitudinally at the junction of its inner and middle third and well retracted, exposing the fibres of the transversalis fascia and the muscle beneath running inward and somewhat upward to the mid-line. At a point two fingers' breadth below the tenth costal cartilage the muscle fibres are split transversely and the peritoneum opened. This split running with the fibres of the trans-

versalis, slightly upward and inward, is lengthened under the inner and outer portions of the retracted rectus and the liver edge exposed.

In several instances the gall-bladder has promptly popped into the opening and in others it has been readily reached.

The incision is adequate for drainage of the gall-bladder, and in less muscular cases cholecystectomy and choledochotomy are accomplished without difficulty.

No attempt is to be made to pack above the liver nor to rotate it downward from the diaphragm. On the contrary, the incision made sufficiently high will allow traction upward on the round ligament with rotation backward and upward of the liver, and if it proves inadequate it is easy to convert it into a half-gridiron by making a vertical incision upward or downward from its inner end under the rectus.

Its advantages are a comparative freedom from danger of hernia and its applicability that it is feasible in the conditions in which a hernia is most to be dreaded—in the drainage of a gall-bladder the seat of gangrene or advanced suppuration or in working through a flabby or poorly nourished wall. Under these conditions it has proven a valuable procedure in the author's hands in his work at the Brooklyn Hospital.

JOHN EDWARD JENNINGS, M.D.,
Brooklyn, N. Y.

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REPLACING THE FILE OF THE ANNALS OF SURGERY IN THE TOKYO INTERNATIONAL HOSPITAL

EDITOR ANNALS OF SURGERY:

Sir:

In the great disaster which overwhelmed Japan, St. Luke's International Hospital, Tokyo, the best known foreign hospital in the East, was completely destroyed. Although all patients were safely removed, through the splendid bravery of the Japanese doctors and nurses, no attention could be given to equipment and library, which were consequently lost in the fire following the earthquake.

One of the first requests that has been made by the hospital authorities is for recent medical books, and files for the past ten years of the leading medical journals. Can you give us any assistance in replacing the destroyed file of the ANNALS OF SURGERY? Would it be possible through your columns to make this need known, in the hope that some of your subscribers might be willing to part with their copies? If this can be done, may I suggest that all communications with reference to any proposed gift should be directed to the Church Periodical Club. This will avoid possible duplication and consequent wasting of the periodicals. We are acting as the hospital's official agents in this appeal, as it looks to us to assist largely in replacing the medical library.

Faithfully yours,

MARY E. THOMAS,

*Executive Secretary, Church Periodical Club,
2 West 17th Street, New York City.*

too may react favorably to an improvement in the cardio-vascular activity.

* From the Gynecological Service (Doctor Brettauer), Mt. Sinai Hospital, N. Y. C.
† Geist and Somberg: *Amer. Jour. Obstet. and Gynec.*, vol. iv, No. 2, August, 1922.

CORRESPONDENCE

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EFFECT OF PRE-OPERATIVE DIGITALIZATION IN REDUCING POST-OPERATIVE COMPLICATIONS*

By SAMUEL H. GEIST, M.D.

OF NEW YORK, N. Y.

ASSOCIATE GYNECOLOGIST, MT. SINAI HOSPITAL

AND

MORRIS A. GOLDBERGER, M.D.

ADJUNCT GYNECOLOGIST, MT. SINAI HOSPITAL

POST-OPERATIVE complications, especially those involving the respiratory tract, have always been a source of anxiety to the surgeon, and because of this fact we have been utilizing a procedure to minimize these conditions; a method that was described by one of us in association with Doctor Somberg last year.†

We classified the post-operative complications under the groups of vascular and non-vascular, and we were convinced that the pulmonary complications to a large extent were dependent on the vascular variations. The so-called hypostatic pneumonia we felt was due to a circulatory stasis in the lungs with poor aeration, upon which was superimposed an infection. Pulmonary edema, another well recognized post-operative complication, is definitely of circulatory origin.

Miller and Polak have shown that there is a definite post-operative drop in blood pressure, the average being 14.2 mm. The return to normal usually takes twenty-four hours. It is this fall in blood pressure that results in a stasis in the smaller arterial and venous radicles. Studies carried out with the micro-capillary tonometer in observing the capillary changes immediately post-operative might add much to our knowledge of the circulation during these important first twenty-four hours. It is in all probability this first twenty-four hours that determines to a great extent the pneumonia or other vascular complications. We feel that probably all post operative pneumonitis excepting those cases that are distinctly aspiratory have an etiology similar to the so-called hypostatic pneumonias. Other vascular lesions, such as embolism and thrombosis, are occasional post-operative complications, but just how much they are influenced by a maintenance of the post-operative pressure can only be judged after a very large series, as the incidence of their occurrence is very small.

Phlebitis may be due to operative trauma upon which is superimposed an infection; but here, too, stasis may play a rôle, and from that point of view, it too may react favorably to an improvement in the cardio-vascular activity.

* From the Gynecological Service (Doctor Brettauer), Mt. Sinai Hospital, N. Y. C.

† Geist and Somberg: Amer. Jour. Obstet. and Gynec., vol. iv, No. 2, August, 1922.

In post-operative shock we know there is a marked fall in pressure, and it seems rational to suppose if the pressure level can be maintained, a large group of patients may be spared this complication or at least that it may be distinctly lessened in gravity.

It was with these theoretical considerations in view that it was determined to try the value of some drug that would be a cardiac stimulant and would help maintain the blood and pulse pressure levels.

Digitalis was selected. To determine the action of the digitalis on these apparently normal hearts two methods were used, the study of the electrocardiographic tracing and the pulse and blood pressure. We found that we could get complete digitalization without any untoward effect on the patient and that the pulse rate in normal hearts was uninfluenced. The pressure was taken pre-operatively and six, twelve and twenty-four hours after operation. The average drop was found to be only 3 mm. within the first twelve hours, after which the tension gradually returned to normal.

At the time of the publication of the original paper we used two methods, the *slow* and the *rapid method*. We have found that the slow method had certain advantages, namely, ease of administration and absence of the digitalis nausea and vomiting, and for these reasons, of the 100 cases in the second series, all but eight were digitalized by the slow method. In the slow method digitan tablets, each $1\frac{1}{2}$ grains, were used instead of the standardized tincture of digitalis. We give one tablet of digitan per fifteen pounds of body weight as the total amount. The first dose is given twenty-four hours before operation and then every two hours until the entire amount is taken. On the morning of operation two more such doses at two hour intervals are given and occasionally twelve hours post operative or twenty-four hours post-operative another dose can be administered. Digitan is standardized by its manufacturers, $1\frac{1}{2}$ grains being equal to 1.5 c.c. of the standardized tincture. The digitalization effects last ten to fourteen days, so that if operation is deferred a few days, patients should not be redigitalized, as in such instances one may get nausea and vomiting or other distressing symptoms of poisoning.

TABLE I

Complete hysterectomy	9
Supravaginal hysterectomy & bilateral salpingo-oophorectomy	40
Plastics	14
Plastics with ligation of tubes and ventro-fixation	5
Removal of adnexa, ectopics, cysts, hydro-salpinges	15
Vaginal hysterectomy	6
Myomectomies with appendectomy or Alexander operation or ventro-suspension	6
Alexander operation	1
Exploratory laparotomy	2
Curettage and Dudley	1
Nephrectomy and ureterectomy	1

In comparing the results obtained in our first series of cases we found, aside from the improved subjective symptoms and the general better impression of the post-operative convalescence, that the pulmonary complications had been definitely lessened from 15 per cent. in the nondigitalized cases to 0 per cent. in the digitalized.

We have carried on the work in an additional 100 major gynecological operations picked at random with a tendency to relegate to the digitalization group the poorer risks. Table I comprises the list of cases digitalized.

In this group of cases there were three that developed complications referable to the circulatory stasis. The histories are briefly abstracted below:

CASE I.—R. C. Supravaginal hysterectomy and appendectomy. Operating time, thirty-four minutes. Gas and ether anaesthesia. Six days post-operative developed fever which rose to 103.6 and on the tenth day dropped by crisis. The medical consultant found at the right base an area of consolidation about the size of a twenty-five cent piece. Over this area were a few subcrepitant râles and broncho-vesicular breathing. In the pelvis, however, was felt a massive exudate in both broad ligaments fixing the cervix. The question arises how much the minute lesion in the lung contributed to the condition. However, it is classed as a case of post-operative broncho-pneumonia.

CASE II.—L. P. Supravaginal hysterectomy and bilateral salpingo-oophorectomy and appendectomy. Operating time, one hour. Gas and ether anaesthesia. During the operation the patient vomited and aspirated some of the vomitus. The next day patient developed a cough and had dullness over the right lower lobe, bronchial breathing, moist râles and purulent sputum. Diagnosis:—broncho-pneumonia, confirmed by the medical consultant.

CASE III.—Y. C. Pan-hysterectomy and bilateral salpingo-oophorectomy. Operating time, one hour, five minutes. Gas and ether anaesthesia. On nineteenth day post-operative temperature rose to 102. Patient complained of pain in left thigh. There were no objective findings but a tentative diagnosis of phlebitis was made. Temperature dropped to normal next day and patient was discharged well on the twenty-fourth day post-operative.

In reviewing these cases we find in a series of 100, 3 per cent. complications, a very decided improvement over the reported percentage by various men, ranging from 8 per cent. to 27 per cent. in non-digitalized cases.

The 2 per cent. of post-operative pneumonia is open to question. The first case with the massive pelvic exudate is decidedly a case that admits of some discussion. The second case seems to be one of aspiration pneumonia, and no method of vascular stimulation can prevent such a calamity.

The third case of phlebitis was not proved, but we felt it fair, in view of the fact that the diagnosis was made, to include it in our record. There was no mortality in these 100 cases.

Comparing our results in this series with any random group of non-digitalized cases we feel that it confirms all the advantages previously claimed. It would seem, therefore, that it would be a decided advance to use this method as a routine for operative preparation just as much as the shave, tub, enema and morphine. The method is simple of execution, accurate in dosage and non-toxic in its effect if the directions are followed.

CARDIORRHAPHY IN ACUTE INJURIES

WITH REPORT OF TWO CASES AND A TABLE OF REPORTED CASES

By WILLIAM RANDOLPH SMITH, M.D.

OF ATLANTA, GA.

DEPARTMENT OF SURGERY EMORY UNIVERSITY MEDICAL SCHOOL

THERE is still a deal of romance connected with surgery of the heart, not only in the minds of the laity, but among the medical profession as well. When we realize that cardiac surgery has been considered possible only during the past twenty-seven years, and that during that time only a comparatively few cases of cardiorrhaphy have been attempted, it is easy to appreciate why such occurrences are of interest. The necessarily high mortality in heart wounds has led to a general belief among the laity that this type of injury is always fatal.

CASE I.—I chanced to be in the emergency clinic at 11.30 P.M., February 12, 1923, when a colored boy, twenty-two years old, was brought in by the ambulance. According to some of his friends who came with him, he had been stabbed with a pocket knife during an altercation. The stabbing had occurred approximately 15 minutes prior to his arrival at the hospital. His clothing was soaked with fresh blood, but the only wound he showed externally was a vertical stab wound $\frac{1}{2}$ inch long, in the third left intercostal space, 3 inches from the mid-sternal line. There was no outward bleeding from the wound at the time I saw him. The boy was unconscious, and somewhat cyanotic; his extremities were cold; his pulse was not perceptible at the wrists; his heart sounds were just discernable with the stethoscope, as a faint, distant rumble. His respirations were slow and very shallow and every gasp seemed to be his last. A provisional diagnosis of stab wound of the heart was made, and the patient immediately transferred to the operating room. It took nearly 30 minutes to set up an operating room, during which time the anterior chest wall was cleaned off and painted with 3 per cent. iodine. Operation was started under novocain anaesthesia, approximately 45 minutes after receipt of the injury. A 5 inch incision was made over the fourth left rib and about 3 inches of this rib and costal cartilage were resected sub-periosteally. The pleura was then opened along the line of the skin incision. No effort was made to stay outside of the pleural cavity, for this had been opened by the original injury, and a haemopneumothorax already existed. In order to get a slightly better exposure, a vertical incision was made downward from the original incision for a distance of about 2 inches. (See Fig. 1.) This gave a very good view of the distended pericardium which showed a vertical slit nearly $\frac{3}{4}$ of an inch long in its anterior surface, partly plugged with blood clot. From this partially occluded opening, trickled a steady stream of blood. The heart seemed practically motionless. The edges of this incision in the pericardium were grasped in Allis clamps, and the wound explored with a gloved finger. A wound in the heart wall could be felt. This procedure liberated the occluding clot, and resulted in a gush of blood through the pericardial wound. Simultaneously with this, the patient's general condition improved considerably and he began to show signs of returning consciousness, and his respirations improved. Ether, by the drop method, was then administered. During induction of the anaesthesia,

CARDIORRHAPHY IN ACUTE INJURIES

the wound in the heart was plugged with a gloved finger of the left hand. The pericardium was then opened widely in the vertical direction, and the apex of the heart grasped in an Allis clamp. By this means, the heart could readily be lifted up to the opening in the chest wall. Traction on the heart resulted in throwing the whole organ into fibrillation, from which it readily recovered a normal rhythm with the release of the pull. The wound in the heart proved to be nearly $\frac{3}{4}$ of an inch long and was situated in the upper portion of the right ventricle, close to the conus arteriosus. With the heart held in this way, it was a very simple matter to suture the wound. This was done with a continuous suture of chromic catgut on a curved intestinal needle, making 5 insertions. This suture controlled the hemorrhage completely. The sutures were placed through the entire thickness of the ventricular wall; which at this point is not very great. The posterior surface of the heart was rapidly explored and found to be uninjured. The pericardium was then sutured with a continuous suture of chromicized gut, leaving a small aperture at the lower angle of the wound in case of slight oozing. Following this, the lung was inspected, but no injury to this viscus was found. The blood that had accumulated in the pleural cavity was hastily removed, and the chest wall closed in layers, without drainage.

Clinical Course.—The patient was sent to the ward with a pulse of 130 beats per minute, regular and of a fairly good volume. During the operation, he had received 1000 cubic centimetres of normal saline, subcutaneously. Although he was in considerable

shock, he was placed flat in bed. It was deemed inadvisable to elevate the foot of the bed because of the added strain which that position might place upon the right heart. He was given a retention enema of a pint of hot tap water as soon as placed in bed, and this was repeated in 30 minutes. Thereafter he received eight ounces of water in this way every 4 hours for the first 24 hours. All of this he retained and absorbed readily and at no time did he suffer from thirst.

During the next two days, a number of his friends were matched as prospective donors for transfusion. His condition seemed very favorable, so it was deemed advisable to delay transfusion until reports on the donors' Wassermann tests were received. On his third day post-operative, he was given 300 cubic



FIG. 1.—Photograph taken during the fourth week post-operation. The blue rate type is not used.

centimetres of whole blood by the Lindeman method. This procedure was repeated on the fourteenth day after operation, at which time 500 cubic centimeters of blood was introduced. He had no demonstrable, unfavorable reaction following either transfusion; his general condition seemed improved, and he said that he felt much better.

His temperature and pulse remained elevated during the first 16 days, the temperature staying between 99 and 102 degrees Fahrenheit, and the pulse between 115 and 130 beats per minute. Thereafter the temperature and pulse gradually

descended so that by the end of the third week he had a normal temperature, and a regular, moderately strong pulse of 90 beats per minute.

Examination of his chest during this period revealed the signs of a hæmopneumothorax on the left, and what would naturally be expected, a fairly well marked pericardial friction rub. The heart was displaced to the right. Small amounts of blood were aspirated from the left chest several times, but as the signs did not show much tendency to clear up spontaneously, I decided at the end of the fourth week, to drain the left pleural sac. A valve tube drain was inserted in the posterior axillary line between the seventh and eighth ribs. This type of drainage tube (see Fig. 2) was first suggested, as nearly as I can learn, by Tuffier, and I have found it very useful in a number of cases where a hæmopneumothorax existed. Air and fluid can readily be expelled through the tube from the chest, but nothing can get back, for as soon as even the slightest suction is applied at the chest end, the thin walls of the condom fall together and



FIG. 2.—Photograph showing the valve tube drain in place in chest wall.

occlude the opening of the tube. In this way the fluid is removed and the lung expanded. X-ray examinations at intervals during convalescence showed a gradual improvement in his chest condition. The heart returned eventually, to the left side of the thorax.

During the fifth week of his illness the pericardial friction rub became less distinct. By the end of the sixth week, it was almost impossible to detect any abnormality in his cardiac sounds. The patient was allowed out of bed after his third week and since that time he has been up and about every day.

Other features in his progress which are of interest will be mentioned briefly. A few hours after operation, the patient's blood-pressure was 100 systolic and 60

diastolic. The pulse rate was regular, but the volume was irregular. Within 36 hours, the blood-pressure had risen to 120 systolic and 80 diastolic and has remained practically the same ever since. The irregularity in the force of the beats persisted for nearly ten days, gradually becoming less noticeable. A blood count on his second day post-operative showed a red cell count of 2,500,000 cells per cubic millimeter, a white cell count of 14,800 with 85 per cent. polymorphonuclear leucocytes, and a hæmoglobin of 60 per cent. On the day following his first transfusion, his red cells numbered 3,125,000, his white cells 20,000, with 90 per cent. polymorphonuclears, and his hæmoglobin measured 55 per cent. From then on the count, which was repeated every few days, remained much the same. There was a tendency toward a slow, gradual increase in the red blood cells and hæmoglobin, with a proportionate decrease in the white blood cells and in the proportion of polymorphonuclear cells. His urine showed a faint trace of albumen and some pus, as a result of a subsiding urethritis which he had at the time he was injured. This, however, cleared up during his enforced rest in bed.

CASE II.—On the evening of June 18, 1923, a colored girl twenty years old, was brought to the clinic with a history of having been stabbed with a long bladed knife. What little clothing she had on was soaked with blood and she was bleeding profusely from a stab wound in the popliteal space of the left leg. In addition to this wound she presented three stab wounds of the left thigh and one stab wound of the left chest, none of which showed outward bleeding at the time she arrived at the hospital. This last wound was in the left breast about one inch above and one inch to the left of the nipple. Further examination revealed a broken fourth rib, and a hydropneumothorax on the left. The heart sounds were very feeble and distant, and slightly irregular. The patient was semi-conscious, pulseless, and gasping for breath. Her mucous membranes were ashy-pale, and she seemed practically exsanguinated. The wound in the popliteal space was hastily packed, to check the hemorrhage and the patient transferred directly to the operating room, with a tentative diagnosis of stab wound of the heart.

Operation was started as soon as possible under light ether anesthesia. A semi-circular skin incision was made beneath the left breast and this structure was separated from the chest wall and retracted upward. Thus was exposed a fracture of the fourth rib about two inches from the sternum. The costal cartilages of the third and fifth ribs were cut through and intercostal incisions were made in the third and fifth spaces. The flap thus produced was opened outward by fracturing these three ribs. This movement exposed an incision in the pericardium about one inch long, which was immediately opened freely in the verticle direction, revealing a penetrating wound in the upper portion of the right ventricle about one inch long. The heart was beating very feebly and bleeding had practically ceased. During this time an assistant was attempting to introduce saline into an arm vein and adrenalin was introduced into the heart and heart muscle. Despite these measures the heart soon ceased beating entirely. Artificial respiration, direct massage of the heart, and the introduction of saline directly into the left ventricle all were tried but without avail.

Post-mortem examination revealed that in addition to the heart wound, the popliteal vein had been severed and that there was a through and through wound in the anterior portion of the left lung.

History—For many years cardiac surgery was regarded as impossible. In fact one of the master surgeons of his day uttered the dictum, but a little more than a quarter of a century ago, "Let no man who hopes to retain the respect of his medical brethren dare to operate on the human heart." (Quoted from.¹) How odd that sounds today! Sherman² sums up the early history of heart

surgery in the terse statement, "The road to the heart is only 2 or 3 centimetres in length in a direct line, but it has taken surgery nearly 2400 years to travel it." Several factors were instrumental in finally opening up this field to the surgeon. First were the observations of several men, notably Paré and George Fisher, that heart wounds were not always fatal. Then in 1881, Roberts advised the suture of heart wounds. In 1895, several successful experiments in surgery on dog hearts were published. In 1896, Farina (Rome), performed the first cardiorrhaphy. The patient had been stabbed into the right ventricle. The wound was sutured with three silk sutures, and although the patient died of pneumonia on the sixth day, the feasibility of the procedure had been demonstrated and the way opened for the future. During this same year two other cases were attempted, by different surgeons, one of which recovered. To Rehn belongs the credit for the first successful cardiorrhaphy, published by him in 1897. From that year, to the present, the number reported has increased rapidly.

Physiology.—A great deal has been written on the physiology and the physio-pathology of the wounded heart. In this article I shall not attempt to summarize the information gained experimentally on animals and through observations on the human heart. I will mention one or two outstanding points, however, which appears to be of especial interest in connection with the human heart.

1. The human heart is quite tolerant of manipulations and traumatic insults. This has been amply shown by the manipulations to which this organ has been subjected by many surgeons in performing cardiorrhaphy. The heart will stand tugging, pulling, and compression sufficient to cut off all blood from flowing through its chambers, thus arresting circulation completely for a few seconds, and then resume a normal rhythm. The remarkable tolerance of the heart to injury, and to surgical procedures has been well demonstrated in numerous recent post-bellum reports of non-fatal wounds caused by projectiles, which remained in the heart or pericardium for a period of days, or in some cases even years, before surgical intervention was attempted. This work forms an intensely interesting chapter of cardiac surgery. (For brief review of this work see Matas, Keen's Surgery, vol. vii, pp. 713-737.)

2. Irritation of the bundle of His, either directly or indirectly as by pulling on the heart to deliver it into a wound will throw the whole heart into fibrillary contractions from which it recovers rapidly if the irritation is of short duration, such as a few seconds up to even a minute.

3. In many penetrating wounds into the heart chambers, the opening through the pericardium soon becomes plugged or at least partially occluded by blood clots. There results progressive bleeding into a closed pericardial sac, which may be the means of saving life for a short time, but which, if continued, gives rise to the most frequent cause of death in heart injuries, *viz.*: "heart tamponade" or compression. This symptom is the clearest operative indication.

4. Regeneration of muscle in wounds.³ In open wounds of heart muscle

there is no true regeneration. The gap is filled with cicatricial tissue which proceeds from the scanty stroma of the myocardium. Sutured wounds of the myocardium heal with very little connective tissue reaction.

5. *Pneumothorax*.—Acute surgical pneumothorax was at one time dreaded, and various cumbersome pieces of apparatus were devised to combat the effects of this condition. The introduction of the Meltzer-Auer principle of intratracheal insufflation, was doubtless a great advance. Chest work during the recent war, however, has shown that the production of a complete pneumothorax by a large pleural opening is not only practicable, but constitutes the method of election in intra-thoracic surgery. Le Fort makes the statement "Pneumothorax is remarkably well tolerated; there would appear to be no greater risk in opening the pleura than the peritoneum." Furthermore, hemorrhage is considerably decreased in heart wounds as well as pulmonary wounds with the chest wide open. How to deal with the pneumothorax after the operation is another question upon which experiences in the World War have thrown some light. I will deal with this phase of the subject under the heading, "Treatment."

6. *Coronaries*.—Despite the view that the coronaries are end arteries, ligation of these vessels has been done a number of times during cardiorrhaphy without apparent damage to the heart.

Symptomatology and Diagnosis.—The diagnosis of a wound of the heart is not always an easy matter. There are numerous cases on record where cardiac wounds, demonstrated at autopsy, were overlooked by competent surgeons and medical men, as well as cases where the diagnosis of a wound was made, where none existed. There is no pathognomonic sign by which this injury can be definitely diagnosed. Under certain circumstances, as when there is a large wound of the chest wall exposing the heart, or when the wound is large enough to admit an examining finger, the diagnosis is obvious. If the symptoms of heart tamponade are present, these, coupled with the history of the case and with the site and direction of the wound, make the diagnosis relatively certain. Borchardt,⁴ however, claims that this syndrome is more often absent than present. External bleeding is often absent or very scant, or at least has ceased by the time the patient is first seen by the surgeon. This is due to the fact that the external thoracic wound and that of the pericardium, fail to come into apposition. In these cases the diagnosis rests upon the signs of internal hemorrhage, the symptoms of tamponade, the auscultatory signs of cardiac injury or intrapleural hemorrhage. The immediate effect of heart injury in about one-half the cases is unconsciousness, from which the patient may or may not rally shortly. "While it is always desirable and important to make as accurate a diagnosis of the seat of the heart injury as possible, the surgeon can afford to act without the absolute certainty of heart injury in the presence of urgent symptoms calling for an exploratory pericardiotomy. We believe that in the thorax, as in the abdomen, when there is doubt, exploratory operations are perfectly justifiable." While the physical

signs presented in various wounds of the heart are of some didactic interest, they can rarely be used to great advantage in the diagnosis of this condition.

Treatment.—The oldest treatment in these cases was to close the external wound and pack the patient in ice. Later, ice to the precordium, absolute rest, mental and physical, mild stimulation with alcoholics, and the free use of opiates, were used; to this was added venisection after the effects of heart compression were appreciated. Later still, heart compression was relieved by direct tapping of the pericardium. Last, came operative treatment. The operative treatment of cardiac wounds may be considered more conveniently under several headings.

1. *Preparation.*—A very serious complication that may arise following an apparently successful cardiorrhaphy, and one which has not infrequently caused an unsuccessful result, is infection, either within the pericardium, the pleura, or both. While this infection may in some cases be carried in by the force producing the injury, it is as a rule, more likely the result of neglected asepsis during a hastily arranged operation. The large mass of evidence seems to indicate that it is far wiser to delay operation the additional time necessary to provide proper aseptic conditions. Even under such an arrangement, infection may ensue, but the results in the long run, are infinitely better.

2. *Anæsthetic.*—Much has been written on different types of anæsthesia in these cases, and I have referred above to the use of differential pressure devices in this class of work. Suffice it to say here, however, that the consensus of opinion seems to be, that a light ether anæsthesia is the most satisfactory. Anæsthesia is often not necessary till the pericardium is opened, but from this point on general anæsthesia is a decided help in many ways. Local anæsthesia has been used successfully by several operators, but many have tried it and found it necessary to change to general anæsthesia during operation.

3. *Thoracotomy.*—A great variety of approaches to the heart have been advised from time to time. In a general way, these may all be divided into two main classes, *viz.*: transpleural and extrapleural. If we limit ourselves to acute stab and gunshot wounds of the heart as I have attempted to do in this paper, and take into consideration several factors in connection therewith, we can simplify the question as to the type of thoracotomy considerably. In the large majority of these cases there already exists a pleural injury with at least a partial pneumothorax. In a certain proportion of cases (Pool estimated 13 per cent.) there is coincident lung injury, which requires surgical attention. This makes it advisable in all cases to examine the lung for evidence of injury. Also, the patient is often in an extreme condition, and immediate relief is imperative. A transpleural thoracotomy is a quicker and far more simple procedure than one by the extrapleural route. In fact in the hands of the average surgeon, the extrapleural thoracotomy is not very practicable. So then, when we take into consideration also, the relative safety of surgical pneumothorax, we may reasonably come to the conclusion that in this type of work the transpleural thoracotomy is the method of choice, in the

vast majority of cases. A discussion of the various methods and modifications of this procedure here, would necessarily entail a useless repetition of much that has already been written. (For detailed descriptions of procedures see ^{5, 7, 8, 9,} and ¹⁰ of bibliography.)

4. *Opening the Pericardium.*—The safest and most expeditious procedure is to open the pericardium freely in its long axis. This will allow ample exposure of the heart, and will facilitate the quick locating of the site of bleeding. If the pericardium has been greatly distended with blood and heart compression exists, opening of the pericardium will result in a general improvement of the patient's condition, and a markedly increased amount of bleeding. It may be necessary to check this by gently plugging the hole in the heart with a finger of the left hand, while a suture is being placed.

5. *Cardiorrhaphy.*—The advisability of suturing heart wounds is no longer a question of discussion. The only points on which there is any difference of opinion are in regard to details of this procedure. Some prefer to grasp the heart near the base, compressing the cavity, others prefer to grasp it near the apex with the hand, and still others prefer the use of a suture or instrument to hold the tumultuous organ. In my case, I found that a very satisfactory grip could be obtained by using an Allis clamp near the apex. This was sufficient to hold the heart satisfactorily while the sutures were placed and also permitted me to lift the organ and inspect its posterior surface. When no traction was exerted on this clamp the heart action appeared perfectly normal. Most of the early operators used silk for suture material. For a time catgut was advocated and there seemed to be a trend in that direction. Several experimenters have reported that with silk they get a firmer and more resistant cicatrix. (Goebell, also ³) F. T. Stewart,¹¹ however, expresses a preference for catgut, and cites one of his cases sutured with silk, in which the silk suture eventually sloughed through a sinus that developed. There are arguments for and against either continuous or interrupted sutures. At the present time there seems to be no unanimity of opinion on this point. Cases vary of course, but as a general rule, continuous sutures seem to be preferable. They are placed more quickly, and present fewer knots on the surface of the heart. Practically every operator has closed the pericardium with a continuous catgut suture.

6. *Drainage.*—There has been a good deal of discussion on the advisability of drainage in these cases, either of pericardium, pleura, or both; and it is very hard to draw any conclusions from the evidence presented. There has been a large amount of work done in recent years, both during and following the war, on foreign body extractions from the heart and pericardium. These cases unless definitely septic have been, as a rule, closed tight, either with or without the aspiration of the air from the pleural cavity. Should I ever have occasion to perform another cardiorrhaphy, I shall modify the procedure that I used in the case reported in this paper to this extent: I will close the pericardium without drainage, leaving a small opening near the apex and will, as part of the operation, insert through the chest wall in a dependent position in the posterior axillary line, a valve drain, such as I have subsequently used

TABLE I.
Table of Wounds of Right Ventricle.

Surgeon	Year	Patient	Type of wound	Time before operation	Anaesthetic	Type thoracotomy	Suture material	Drainage pericardium	Complications	Result
1. Bradbury ¹⁴	1909	♀ 44	Stab	1 hour	E	O. F. 3-4	Linen	O	O	Recovery.
2. F. T. Stewart ¹⁵	1909	♂ 21	Stab	Soon		O. F. 3-4	Catgut			Died in 1 hour.
3. Djanelidze ¹⁶	1911	♂ 20	Stab	2 hours	E	O. F. 3-4-5	Silk	O	O	Recovery.
4. Krasnopol'skii ¹⁷	1911	♂ 27	Stab	1 1/2 hours	None	O. F. 2-3-4	Silk	O	O	Died in 30 hours.
5. Nassau ¹⁸	1913	19	Stab	Soon	E	O. F. 3-4	Silk	For 48 hrs.	Empyema drained 11 days later	Recovery.
6. De Verteuil ¹⁹	1913	♂ 15	Stab	Soon	E	O. F.				Died on table.
7. Rothfuchs ²⁰	1916	♂	Stab	1 1/2 hours			Sutured	O	O	Died second day.
8. Ertaud ²¹	1916	♂ 20	Shell fragment	Soon		O. F.	Catgut	O	O	Died in 9 hours.
9. Rhodes ²²	1917	♂ 30	Stab	Soon					Attempt to suture unsuccessful due to position of wound	Died in 1 1/2 hour.
10. Adenot and Proby	1919	♂	Stab	3 hours			Sutured		Hemorrhage from wound in lung	Died in 12 hours.
11. Burian ²³	1919	♀ 11	Needle puncture	4 hours		Severed costal cartilages	None used	O	O	Recovery.
12. Pratt ²⁴		♂ 19	Stab	1 1/2 hours		O. F. 3-4-5	Catgut	O	O	Recovery
13. Vidal ²⁵	1922	♂ 34	Stab	1 1/2 hour		Mid-sternal thoracotomy	Catgut	O	O	Recovery.
14. W. R. Smith ²⁶	1923	♂ 22	Stab	1 1/2 hour	E	Resection 4	Catgut	O	O	Recovery.
15. W. R. Smith ²⁶	1923	♀ 20	Stab	1 hour	E	O. F. 3-4-5	Catgut		Other wounds including severed popliteal vein	Died on table

Note: E, Ether, open cone.

O, F., Osteoplastic flap, numbers indicate ribs.

O, None.

Where reporters did not specify details blank spaces have been left.

B., Billroth's A. C. E. mixture.

G., Gun shot wound.

C.-N., Chloroform, ether, alcohol mixture.

TABLE II.
Table of Wounds of Left Ventricle.

Surgeon	Year	Pat- ient	Type of wound	Time be- fore oper- ation	Anes- thetic	Type thoraco- tomy	Suture material	Drainage		Complications	Result
								apic. cardium	pleura		
1. P. T. Stewart ¹⁷	1909	♂ 46	Stab	1 hour	E	O. F. 3-4	Silk	O	Yes		Recovery.
2. Martinez and Capas ¹⁸	1910	♂ 45	Stab	3 hours	Chlor.	O. F. 3-4-5	Sutured	Yes	O	Shock and hemor- rhage	Died in 36 hours.
3. Von Hacker ¹⁹	1910	♂ 46	Stab	24 hours	H	Resection 4-5	Sutured				Died on table.
4. P. T. Stewart ²⁰	1910	♂ 23	Stab	1½ hours		O. P. 4-5	Catgut	O	Yes		Died in 41 hours.
5. Billings ²¹	1911	♂ 31	Stab	Soon	E	O. P. 4-5	Catgut	O	O	Cardiac failure	Died in 48 hours.
6. Schafer ²²	1912	♂ 37	Stab	Soon	E	Resection 4	Catgut	O	O	O	Recovery.
7. Mitchell ²³	1912	♂ 50	Stab	1½ hours		Sixth rib sec- tioned	Linen	For 18 days	O	Alcoholic delirium	Recovery.
8. Lucas ²⁴	1913		Stab				Sutured	Yes			Recovery.
9. Dunn ²⁵	1913	♂ 30	Stab	Soon	Local	O. P. 3-4-5	Catgut	O	O	Broncho-pneumonia	Recovery
10. DeVerteuil ²⁶	1913	♂ 14	Stab	2 hours	E	O. P.	Silk	O	O	Radial and renal emboli	Recovery.
11. Schafer ²⁷	1914	♂ 16	G. S.	Soon	E	Resection 4	Catgut	O	O	Lung abscess later	Recovery.
12. W. J. Coleman ²⁸	1914	♀ 36	Razor cut	Soon	E	Resection 5	Catgut	Yes	Yes		Recovery.
13. M. Prat ²⁹	1914	♂ 30	G. S.	24 hours	Chlor.	O. P.	Catgut	Yes	Yes		Died
14. Pratt ³⁰	1915	20	Stab.	6 hours		O. P. 5-6	Sutured				Died
15. Leveuf ³¹	1915	♂ 19	G. S.	1 hour		Resection 4-5	Catgut	O	O	O	Recovery.
16. J. P. Jones ³²	1916	18	Stab	½ hour		O. P. 3-4-5	Silk	For 4 days	For 13 days		Recovery.
17. P. C. Pybus ³³	1917	♂ 25	Stab	2 hours	E	O. P. 5-6	Catgut	O	O	Severe wounds, other diseases	Died 5 days.
18. Constantin and Vigot ³⁴	1917	♂	G. S.	Few hours	E	Resection 3-4-5	Sutured	O	O	O	Recovery.
19. Butler ³⁵	1918	♂	Stab	4½ hours	E	Resection 5	Catgut	O	O		Recovery
20. Warner ³⁶	1919	♂ 24	Stab	½ hour	E	O. P. 4	Catgut	Yes	Yes	Slight infection	Recovery

TABLE II. (Continued).
Table of Wounds of Left Ventricle.

Surgeon	Year	Patient	Type of wound	Time before operation	Anesthetic	Type thoracotomy	Suture material	Drainage pericardium	Drainage pleura	Complications	Result
21. A. W. Collins ⁴⁶	1920	♂ 20	G. S.	2 days	E	O. F. 3-4-5	Catgut	O	Yes	Pneumonia-empyema, got up on 6th day	Died 11 days.
22. Cappette ⁴⁷	1921	♀ 17	G. S.	1 hour			Sutured	O	O	Pleural effusion	Recovery.
23. Monad ⁴⁸	1921	♀ 30	Stab	3 hours			Sutured	O	O	Pleural effusion	Recovery.
24. Hartman-Keppel ⁴⁸	1921	♂ 47	Rifle bullet	20 hours	Chlor.	Mid-sternal	Catgut	O	O	Thrombosis left axillary artery	Recovery.
25. Santy ⁴⁹	1922		G. S.			Intercostal	Catgut	O	O	Hemothorax	Recovery.

TABLE III.
Table of Wounds of Right Auricle.

Surgeon	Year	Patient	Type of wound	Time before operation	Anesthetic	Type thoracotomy	Suture material	Drainage pericardium	Drainage pleura	Complications	Result
1. F. T. Stewart ⁵¹	1910	♂ 26	Stab	2 hours		O. F. 3-4	Catgut				Recovery.
2. Noland ⁵²	1912	♂ 22	Stab	Soon	E	O. F. 3-4-5	None used			Left hydrothorax	Recovery.
3. Fraser ⁵³	1917	♂	Shell fragment	Soon		Resection 6	Sutured	Yes	Yes	Other wounds	Recovery.
4. Moure and Saupault ⁵⁴	1921		Stab	1½ hour		Mid-sternal	Catgut				Recovery.
5. Migniac ⁵⁵	1922	♀ 24	Stab	1½ hours		Mid-sternal	Catgut	O	O	3 months pregnancy. Right hemothorax	Recovery.

TABLE IV.
Table of Wounds of Left Auricle.

Surgeon	Year	Patient	Type of wound	Time before operation	Anæsthetic	Type thoracotomy	Suture material	Drainage peri-cardium	Complications	Result
1. Long ⁴⁴	1914	♂ 32	Stab	3 1/2 hours	E	O. F. 3-4-5	Catgut	O	Yes	Effusion-pericardial and both pleura
2. Constantini and Vigot ⁴⁵	1917	♂	G. S.	4 hours	E	O. P. 3-4-5	Sutured	O	O	Left empyema
3. Black ⁴⁴	1920	♂ 15	Stab	3 hours	E	O. P.	Catgut	Yes	O	Probable pulmonary embolus
4. Harvey ⁴⁴	1921	♂	Ice pick	Soon	E	O. F.	Catgut	O	O	Wound on posterior surface overlocked
5. Mignone ⁴⁶	1922		Stab				Sutured			Recovery.

TABLE V.
Table of Miscellaneous Cases.

Surgeon	Year	Patient	Type of wound	Position of wound	Time before operation	Anæsthetic	Type thoracotomy	Suture material	Drainage peri-cardium	Complications	Result
1. Lucas	1913	G. S.		R. and L. Vent.				Sutured	Yes		Recovery.
2. E. M. Freese ⁴⁷	1920	♂	Stab	R. and L. Vent.	1 1/2 hour	E	O. F. 4-5	Sutured	O	O	Recovery.
3. Quenu ⁴⁸	1920	♂	G. S.	R. and L. Vent.	11 hours	C-M	O. F. 3-4-5-6	Catgut			Died on table.
4. Mocquot and Constantini ⁴⁹	1910	♂ 10	Shell fragment	Anterior coronary artery	6 days	E	O. P.	Sutured	O	O	Recovery.
5. Burian ⁴⁴	1910	♂ 20	Stab	Anterior coronary artery	2 hours		O. F. 3-4-5	Catgut	O	O	Recovery.
6. Mauro ⁴⁴	1910	♂	Hand grenade	Heart wall	1 hour		Resection 5-6	None	O	Yes	Other wounds also Recovery.
7. Lott ⁴⁴	1911	♂	Stab	Heart wall	Soon		Resection 4	None	Yes	Yes	Recovery.
8. Crabtree ⁴⁰	1918	♂	Rifle bullet	Heart wall	4 days		Resection 4-5	None	Yes	Yes	Recovery.

in this case. (See page 698.) In this way, I feel confident that excess accumulations of fluid in the pericardium or pleura will be obviated, the pneumothorax will be rapidly overcome, and drainage against potential infection will be instituted. If infection does not supervene, this tube will soon be walled off by adhesions on the pleural surface and can be removed in ten or twelve days.

Post-operative Treatment.—The post-operative treatment of these cases is naturally directed against shock and hemorrhage. Crile's suggestion about using the Fowler position to relieve strain on the heart, should be followed, rather than placing the head low. Fluids should be administered in the form of saline under the skin and hot coffee per rectum. I prefer not to introduce saline directly into the circulation for the reason that there is no danger of causing an acute cardiac dilatation in these patients. Fluid introduced beneath the skin is taken up by the circulation with surprising rapidity and is probably borne better. Several donors should be matched for transfusion as early as possible, so that in the event of necessity, this procedure may be used. Whole blood transfusions, because of the less frequent, and less severe reactions, are by far the more desirable. The use of digitalis bodies, morphia, strychnia, etc., as well as fluids by rectum, are details of treatment which do not require special mention here.

Statistics.—Statistical studies of cardiorrhaphy have been published from time to time both in this country and abroad. The earlier statistics showed a mortality of 56 to 65 per cent. More recent statistics give a lower mortality. The later statistics, however, may not be as complete as those published earlier, for while today, practically all successful cases get into the literature, undoubtedly many cases terminating fatally are never published. In the earlier days of cardiorrhaphy this was probably not so true. While it is difficult to draw conclusions from published statistics of this kind, we may with reasonable assurance accept certain statements, made as early as 1906¹² as being true today. That is in a general way, cases of heart wounds have 3 chances in 4 of surviving long enough to permit surgical intervention; 1 chance in 10 of healing spontaneously, and about 1 chance in 2 of being cured by surgery. The place where we must improve in connection with this branch of work is in diagnosis. The treatment today is fairly well understood and carried out. If all cases of penetrating heart wounds could be collected, including non-operated cases, the chances are that the mortality rate from such injuries would be higher than we now believe it to be. In my very limited experience, I have seen two cases in which at autopsy unsuspected penetrating wounds of the heart were found. Undoubtedly many cases go unrecognized.

In 1909, Peck¹³ published a table of the reported cases. He found 161 operated cases with a mortality of 63 per cent. In 1912, Pool⁶ amended the list to bring it up to date. He added 79 cases with a mortality of 47 per cent. In the appended tables, I have attempted to collect those cases not included in the above lists, in an effort to bring the figures on cardiorrhaphy up to date. My list contains 58 cases, with a mortality of 33 per cent.

SUMMARY

1. Cardiorrhaphy is a comparatively recent advance in surgery.
2. The human heart is very tolerant of manipulation. This fact has been repeatedly demonstrated, especially in connection with foreign body extractions during and since the World War.
3. Surgical pneumothorax is remarkably well tolerated.
4. The symptomatology of heart injuries varies widely, and as a consequence the diagnosis of this condition is often very difficult. In cases of doubt, therefore, exploratory operations are justifiable.
5. Transpleural thoracotomy under general anaesthesia is probably the procedure best suited to the average case of this type.
6. Drainage in these cases can be accomplished best through the medium of a simple valve tube drain through the chest wall.

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EMPYEMA OF THE PLEURAL CAVITY*

BY GEORGE J. HEUER, M.D.

OF CINCINNATI, OHIO

PROFESSOR OF SURGERY IN THE UNIVERSITY OF CINCINNATI

THERE are certain conditions which we must attempt to meet if we are to satisfactorily treat empyema of the pleural cavity. They are:

1. An early recognition of the disease, whether we intend immediate surgical treatment or not.

2. A low mortality.

3. The prevention of chronicity, *i.e.*, the development of chronic from acute empyema.

4. The shortest possible convalescence.

5. The restoration of the functional capacity of the lung of the involved side to as nearly a normal condition as possible.

6. The certain cure of chronic empyema should it develop; and with a low mortality.

How can we meet these conditions? Obviously one way of approach is by the study of a fairly large, carefully followed series made with the purpose of discovering the factors which have contributed toward or prevented their realization. We have made such a study of 455 cases of empyema, 425 of which occurred in the Johns Hopkins Hospital series and 30 in the Cincinnati General Hospital series the past year; and we shall consider the above conditions in the light of these studies.

1. *Early Recognition of Empyema.*—This from a surgical viewpoint is a difficult condition to meet, for the early diagnosis of empyema will remain in the majority of instances in the hands of the internist and general practitioner, and therefore largely out of our control. But we may as surgeons emphasize the importance of early diagnosis and early surgical consultation, for a study of our cases seems to show the evil effects of tardy recognition of the disease. That empyema has frequently been recognized late in the past and is still recognized late in many instances has been our experience. Of the 425 cases in the Johns Hopkins Hospital series 213 had symptoms of empyema for 1 to 4 weeks before entering the hospital, only 1 of which had been operated upon; 81 had symptoms of empyema for 1 to 3 months, only 4 of which had been operated upon; 40 had symptoms for 3 to 6 months, only 14 of which had been operated upon; and 21 had symptoms for 6 to 12 months, of which 11 had been operated upon. Fifty per cent. of the total series of cases therefore had been rather promptly recognized, while the other 50 per cent. had either not been promptly recognized or, if so, had not been promptly treated. The harmful effects of such tardy recognition of the disease cannot be dogmatically stated, for there are factors concerned which

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are difficult to interpret. Yet our studies show, I think, that tardy recognition and late treatment contribute (a) toward the development of serious complications, (b) to a higher mortality, and (c) to prolonged convalescence and chronicity. At the time of their admission to the hospital with empyema, 20 cases in our series had pulmonary abscesses or gangrene, 8 had septicaemia (confirmed by blood culture), 4 had general peritonitis, 3 had suppurative pericarditis, 3 had meningitis or endocarditis and 9 had bronchial fistula due to the rupture of the empyema into a bronchus. Forty-seven cases therefore (10 per cent. of the entire series) had very serious complications in addition to empyema, and our records show that three-fourths of the total mortality in the entire series occurred in the group of cases with the above complicating conditions. I will grant that it is difficult to say that in the above cases with serious complications the empyema was primary, the complicating conditions secondary; for such complications may be manifestations of a general infection of which empyema is one. But I feel sure that a certain proportion of these complicating conditions follow acute empyema if left untreated, a view which is abundantly supported by our experience with infected thoracic war-wounds in France. Not only then is the danger of serious complications and thereby the mortality increased by tardy recognition, but the convalescence in empyema is prolonged and the tendency toward chronicity increased. In the Johns Hopkins Hospital series, 67 patients were admitted with chronic empyema and draining sinuses the result of operations performed elsewhere; and 20 cases operated upon primarily at the Johns Hopkins Hospital became cases of chronic empyema. In the Cincinnati General Hospital series of 30 cases admitted in the past year 7 were cases of chronic empyema. Ninety-four cases therefore (exclusive of the cases of tuberculous empyema) in a series of 455, or 20.7 per cent., were on admission cases of chronic empyema or subsequently became cases of chronic empyema. When we review the histories of these cases we find that in the large majority, operation was performed late—after weeks or months of evident empyema. When we compare with these the period of convalescence and the percentage tendency to chronicity of acute cases promptly recognized and treated, we feel sure that delayed recognition and late treatment of empyema is one of the causes of prolonged convalescence and chronic empyema.

2. *A Low Mortality.*—In order to attain as low a mortality as possible in the treatment of empyema, we must know the factors which contribute to the mortality in this disease. They are many and varied; and, while practically several of them may, in a given case, be operative, we shall for the moment treat them separately.

(a) *Age.*—When we study the mortality of empyema according to age periods, we find that in infants under two years of age the mortality is 39 per cent., that it drops in children from 2 to 5 years to 16.4 per cent., and reaches its lowest level (1.6 per cent.) in children from 5 to 10 years of age. It rises from this period, being 11 per cent. in young adults from 11 to 20 years of age; 16 per cent. in adults from 21 to 30 years, 17 per

cent. from 31 to 40 years, and 34.8 per cent. from 41 to 50 years. From this second high peak it again drops to 7.7 per cent. in adults over 50 years of age. The highest mortality in empyema therefore according to our records occurs in infants under two years of age and in adults between 40 and 50 years of age; the lowest mortality occurs in children from 5 to 10 years of age.

(b) *Etiology of the Disease.*—Studied from the standpoint of etiology the mortality in post-pneumonic empyema was 10.9 per cent., in tuberculous empyema was 42.8 per cent., in post-operative empyema was 41 per cent., in post-traumatic empyema was 33 per cent. and in empyema due to a miscellaneous group of infections 40.5 per cent. Etiologically, therefore, the highest mortality occurs in the tuberculous empyema, the lowest in the post-pneumonic empyema.

(c) *Type of Infecting Organism.*—Studied from the standpoint of bacteriology the pneumococcus empyema showed a mortality of 9 per cent., the streptococcus pyogenes empyema of 22.5 per cent., the streptococcus hemolyticus empyema of 15.5 per cent., the staphylococcus empyema of 17 per cent. and the influenza bacillus empyema of 16 per cent. In this series streptococcus pyogenes empyema shows the highest mortality; pneumococcus empyema the lowest mortality.

(d) *Presence of Complicating Conditions.*—As above noted by complicating conditions, I refer to acute or unresolved pneumonia, either unilateral or bilateral, pulmonary abscess, pericarditis, peritonitis, meningitis, septicæmia, etc. Studied from the standpoint of the presence or absence of complicating conditions at the time of admission for empyema, we find that the mortality of empyema when such complications are present is 48 to 50 per cent.; in the absence of such complications is 6.5 per cent.

(e) *The Duration of Symptoms before Operation.*—Studied from the standpoint of the duration of symptoms of empyema before operation was performed, the mortality in the 213 cases with symptoms of empyema of 1 to 4 weeks' duration was 20.6 per cent.; in the 81 patients with symptoms of 1 to 3 months' duration was 9.8 per cent.; in the 40 patients with symptoms of 3 to 6 months' duration was 10 per cent.; and in the 67 patients with symptoms of over 6 months' duration was 9 per cent. The comparatively low mortality in patients with symptoms of long duration is to be expected and has no bearing on my remarks concerning the value of early diagnosis and prompt surgical consultation; for the majority of patients who have survived the first four weeks of empyema are those who have escaped the serious complicating conditions to which I have just referred. But that they have not entirely escaped and that they have suffered from the lack of prompt treatment is indicated by a study of the autopsy records of those dying. Of the 28 deaths which occurred in those with symptoms of more than 1 month's duration 14, or 50 per cent., showed at autopsy some serious complicating condition such as lung abscess, pericarditis, septicæmia, meningitis and bronchopneumonia.

(f) *The Kind of Anæsthesia.*—It is indeed difficult in this series to form any certain estimate of the influence of the various forms of anæsthesia upon the mortality. Ether, chloroform, nitrous oxide-oxygen and local anæsthesia were all used. Naturally local anæsthesia was the anæsthetic of choice in the most dangerously ill patients and therefore judged purely from the standpoint of anæsthesia the mortality is highest in this series following operations under local anæsthesia. This we know is incorrect, for the deaths were not anæsthetic deaths but deaths due to serious complicating conditions. On the other hand, we have some evidence of the harmful effects of general anæsthesia. A careful analysis of the deaths in this series shows that 3 patients apparently free from the condition before operation developed an acute bronchopneumonia which was at least the immediate cause of death; one patient died upon the operating table from the aspiration of pus through a bronchial fistula—a death which might have been averted—and one patient died upon the operating table either from anæsthesia or pleural reflex or acute surgical pneumothorax, it is not clear which. We have evidence therefore that the kind of anæsthesia is a contributing factor in the mortality, although of slight importance as compared with the others we have enumerated; and that local anæsthesia is the safest and therefore the best whenever it can be used.

(g) *The Kind of Operation.*—For the present we shall speak only of the operations for acute empyema; leaving the subject of chronic empyema to be discussed later. They are commonly three in number, *i.e.*, aspiration drainage, meaning by that the establishment of continuous air-tight suction drainage without the production of pneumothorax; intercostal incision with drainage, and rib resection with drainage. A study of our cases shows that in a certain and relatively large group of cases, *i.e.*, those not seriously ill in which the empyema is localized in the sense that the visceral and parietal pleuræ have become adherent about the empyemic cavity, the kind of operation has little influence upon the mortality. On the other hand, the kind of operation performed becomes a factor of great importance in the mortality in two groups of cases—those which are dangerously, acutely ill with marked toxæmia; and those with unilateral or bilateral pneumonia. In both groups the least possible operation which will suffice alone is permissible; in the latter group especially surgical pneumothorax must be prevented. We have noted a striking improvement in our mortality rate, especially in children, since we have substituted aspiration drainage for rib resection; and due, we believe, to the lessening of the seriousness of the operation and to the prevention of surgical pneumothorax.

(h) *The Kind of Post-operative Treatment.*—It is obviously difficult to form any just estimate of the influence of the post-operative treatment upon the mortality. So many factors come into play, namely the age of the patient, the etiology of the disease, the presence of complicating conditions, etc. In the Johns Hopkins Hospital series the operation (rib resection and drainage) was practically a constant, the post-operative treatment a variable.

Among 221 cases with no special post-operative treatment the mortality was 20 per cent.; in 65 cases treated with boric acid, weak bichloride and other irrigations, the mortality was 9.2 per cent.; in 50 cases treated by the Carrel-Dakin method the mortality was 4 per cent. It is perfectly clear that these mortality rates cannot be attributed to the kind of post-operative treatment; for an analysis of the first group, for example (those without any special post-operative treatment; mortality 20 per cent.), shows that a fairly large percentage died within 24 to 48 hours after operation before any form of post-operative treatment could have had any marked influence upon the course of the disease. Yet when we survey our experience we feel sure that the kind of post-operative treatment does influence the mortality and by quickly overcoming the toxæmia, by promptly controlling the infection and therefore the development of serious complications and by shortening the convalescence and therefore avoiding chronicity. Undoubtedly in our own experience the post-operative treatment of empyema by the Carrel-Dakin method has contributed to our results.

These, then, are the factors which a study of our cases has shown contribute to the mortality in empyema, and to which we must direct our attention if we are to attain a low mortality in the treatment of the disease. Which of them are of prime importance, which of lesser importance may be gathered from a closer study of our deaths. When we study the *factor of age*, which has so large an influence upon the mortality, we find the following:

In infants under two years of age the mortality in the Johns Hopkins Hospital series, as previously noted, was 39 per cent. Of the 16 deaths which occurred, autopsies were obtained in 10; and in these death was not due to simple empyema but due to the serious complications which I have previously enumerated. In 6 cases autopsies were not obtained and the exact condition is not known. In children from 2 to 5 years of age there were 13 deaths (mortality 16.4 per cent.), 12 of which were due to serious complicating conditions, either in the lungs or elsewhere. In children from 5 to 10 years of age, there was 1 death (mortality 1.6 per cent.), and that due to pericarditis. It is clear that in the last group the low mortality was due to two factors, *i.e.*, to the fact that the empyemas were post-pneumonic and that the disease was not associated with serious complications. When we examine the deaths in the succeeding age groups we find again that they are due to serious complications associated with empyema and to the introduction of other factors, such as traumatic conditions, post-operative complications and tuberculosis. We see therefore that age is a factor in the mortality only insofar as it predisposes to or is associated with serious complicating conditions. In infants the mortality is high because of the serious nature of the pulmonary infection which precedes and accompanies empyema. Infants stand infection badly, they are prone to develop bilateral pneumonia, bilateral empyema, multiple pulmonary abscesses, septicæmia and the complications of systemic infection. In children from 5 to 10 years of age, the mortality is low because perhaps of the less serious nature of the

primary pulmonary infection and certainly because of the absence of serious complications. In adult life the mortality again rises, due in part to the complications which accompany the empyema but due in part also to the introduction of new factors which become operative in adult life, *i.e.*, traumata, surgical operations, unusual infections and tuberculosis. In the aged the mortality again drops because the empyemata are post-pneumonic and unassociated with serious complications.

Similarly, when we study *the factor of the kind of infecting organism*, we find that the mortality in pneumococcus empyema is low, because proportionally it is less frequently associated with serious complicating conditions; that the mortality in streptococcus and tuberculous empyema is high, due in part to the graver toxæmia but in greater part to the proportionally higher incidence of serious associated complicating conditions.

In the light of these studies it becomes evident that the factor which contributes in largest measure to the mortality in empyema is the presence of serious complicating conditions. In order to attain a low mortality in the disease we must aim to make an early diagnosis, to recognize by physical, X-ray and other examinations the presence of complicating conditions; and our treatment must be directed toward supporting the strength of the patient, toward avoiding all unnecessary trauma by operative measures, toward preserving the greatest possible function of the lungs by avoiding surgical pneumothorax, and toward lessening and controlling infection by appropriate post-operative measures.

3. *The Prevention of Chronicity.*—An examination of the reports from various hospitals shows but few accurate statements regarding the incidence of chronic empyema. Wilensky, reporting the cases of empyema at the Mt. Sinai Hospital between 1903–1915, found that 23 per cent. of the cases developed chronic empyema. Other statistics are not so clear, but it is evident that in any large series of cases the incidence of chronic empyema has in the past been relatively high. In the above series of 455 cases, 94, or 20 per cent., either were chronic on admission or were acute and became chronic following treatment. It was this fact which originally stimulated us to study empyema in the hope of reducing the incidence of chronic empyema.

We shall reserve for a subsequent paragraph some remarks upon the pathology of chronic empyema and confine our attention here to the factors which clinically seem to be responsible for the development of chronic empyema. A study of the cases admitted with chronic empyema and of those admitted with acute empyema, which subsequently became chronic, shows that the factors involved are (a) delayed operation—by that meaning the presence of empyema for weeks or months before drainage is instituted, (b) the failure to produce adequate drainage, (c) the failure to overcome the infection of the pleura, and (d) the failure of constant supervision in post-operative care until it has been proven by physical and X-ray examinations that the lung has completely expanded and the empyemic cavity has thereby been obliterated. All these factors when closely examined show the impor-

tance of infection in the causation of chronic empyema and the necessity of overcoming it in preventing chronicity. The constant finding in chronic empyema is thickened pleura, the parietal pleura being always much thicker than the visceral. It is caused by infection, for we have proven that so soon as the infection is removed the thickened pleura disappears. It is the cause of the failure of the lung to expand and the reason for the persistence of the cavity. Delayed operation by causing thickened pleura, inadequate drainage, the presence of pockets, and foreign bodies and the results of inadequate post-operative supervision are factors dependent upon infection. In the prevention of chronicity, therefore, we must direct our attention particularly toward overcoming or providing conditions so that nature may overcome the intrapleural infection. It may be accomplished in various ways. J. M. Flint and B. Douglas, working in the Yale Clinic at New Haven in a series of 102 cases of acute empyema which will be reported, have not had a single case of chronic empyema develop. Their procedure has been rib resection with constant suction tube drainage. They have not made use of irrigations nor the Carrel-Dakin method. We, using aspiration drainage or rib resection with air-tight suction drainage depending upon the condition of the patient and making use of the Carrel-Dakin method in the post-operative treatment, have had no case of chronic empyema develop from an acute empyema in the past four years. Other methods may be as adequate, providing they are employed reasonably early and ensure the prompt elimination of the intrapleural infection. The criteria for satisfactory progress in the post-operative course are the rapid disappearance of toxic symptoms; the rapid fall of the temperature to normal, the decrease in the amount of the discharge and the constant progressive diminution in the size of the intrapleural cavity as determined by periodic X-rays and actual measurements. No patient with acute empyema should in our opinion be discharged from the hospital until it has been proven that the lung has completely expanded and the cavity has been entirely obliterated; for only under these conditions may we be sure that the condition is cured.

4. *The Shortest Possible Convalescence.*—Our remarks upon this subject form a corollary to those we have made in the preceding paragraph. Prolonged convalescence is a manifestation of chronicity and therefore in attaining the shortest convalescence we must study the factors which contribute to chronicity. As previously noted they include (a) delayed operation, (b) inadequate drainage, (c) the failure to overcome the intrapleural infection, and (d) the failure of adequate post-operative treatment. The first three of these factors require no further discussion, the fourth—the failure of adequate, constant post-operative supervision—should perhaps be discussed more fully. In the Johns Hopkins Hospital series we have studied the late results from various viewpoints, one of which has been the period of convalescence following various forms of post-operative treatment. With an average hospitalization period of 36 days, 12.2 per cent. of the cases receiving *no special post-operative treatment* were discharged with their empyema cured, 67.8 per

cent. with draining sinuses; 10.7 per cent. of the cases treated after operation with *boric acid or other irrigations* were discharged cured, 80 per cent. with draining sinuses; and 45 per cent. of the cases treated after operation by the *Carrel-Dakin method* were discharged cured, 55 per cent. with draining sinuses. The great increase in the percentage of cures in a 36-day interval following the Carrel-Dakin treatment is a striking commentary upon the value of adequate post-operative treatment. Now when we follow the after-history of patients discharged from the hospital, we find that those discharged with their empyemic cavities obliterated and their sinuses healed remain well practically without exception. Of those discharged from the hospital with cavities unobliterated and with draining sinuses, 80 per cent. eventually heal and get well while 11 per cent. fail to heal. Thus a fairly large proportion of cases do get well, but when we study the period of convalescence of those discharged from the hospital with draining sinuses, we find that over 75 per cent. require over three months for healing and many six months or a year; while as above noted 11 per cent. entirely fail to heal. These findings indicate that the shortest possible convalescence can be obtained only by continuous hospital treatment; and if this treatment is adequate our records and those of Flint and Douglas show that the large proportion of cases of acute empyema can be cured in 40 days, by cured meaning the obliteration of the cavity and the healing of the sinuses. So important has this matter seemed to us that we have in the past three or four years, in cases under our personal supervision, refused to discharge a patient with acute empyema from the hospital until he has been cured.

5. *The Restoration of the Functional Capacity of the Lung of the Involved Side.*—From a study of our end results the restoration of the functional capacity of the lung upon the involved side would seem to depend upon two factors: (a) upon the time after the development of the disease at which primary treatment is instituted and (b) upon the period of post-operative convalescence. Our records show that patients admitted for primary treatment from one to six months after the development of empyema have retraction of the thorax, thickening of the pleura, obliteration of the costo-diaphragmatic sulcus and fixation of the diaphragm; and therefore diminished functional capacity of the lung; that patients admitted for primary treatment early in the disease are less prone to these conditions. I have examined by physical methods, by the fluoroscope, by X-ray plates and by functional capacity tests about 130 patients in the above series—and anywhere from two months to several years after their primary treatment. The results of these examinations show that when obliteration of the cavity and healing of the sinus takes place promptly there is no retraction of the chest, no drooping of the shoulder, no scoliosis, no thickening of the pleura, and in rare instances only, any fixation of the diaphragm; and no diminution in the functional capacity of the lungs; in other words, restoration to the normal is complete. On the other hand, when convalescence has been prolonged, *i.e.*, when the obliteration of the cavity and the healing of the sinus has required months,

retraction of the chest, thickening of the pleura, fixation of the diaphragm and diminished functional capacity of the lung have been relatively common. It seems clear therefore that in order to restore the involved side to normal we should aim at early primary treatment and prompt cure.

6. *The Certain Cure of Chronic Empyema with a Low Mortality.*—Our previous remarks show the enormous advantages of preventing chronic empyema from the standpoints of mortality, prolonged convalescence and disability. Our experience and that of others moreover shows that with proper methods chronic empyema may be almost entirely prevented. It is not unreasonable to hope that chronic empyema will disappear as a surgical disease; but that time has not yet come, and those interested in thoracic surgery still see a distressingly large number of cases. It is indeed a difficult surgical condition to treat; and a study of the literature shows that the results of various methods of treatment are none too brilliant and the mortality attending them relatively high. It is well worth while therefore to study the condition as it presents itself and to devise and attempt procedures which may cure it.

A study of the pathology of chronic empyema shows an intrapleural cavity surrounded by an *infected thickened pleura*. The cavity may be single and is usually ovoid; or it may be irregular, longer or shorter prolongations (pockets) extending from the main cavity in various directions. The pleura is invariably infected; not only its presenting surface, but often also, as microscopic sections and cultural studies show, its sub-surface deeper portions. Of the two pleural leaves the parietal pleura is in my experience always thicker than the visceral. That is the usual picture; but there may in addition be one of several bronchial fistule communicating with the cavity, or a chronic suppurative focus in the lung or a foreign body or a focus of infection in a rib.

In answer to the question why does the condition persist, there are two chief factors to be taken into consideration. (1) The failure of the lung to expand and (2) the continuance of the infection.

(a) *The Failure of the Lung to Expand and Obliterate the Cavity.*—The causes assigned for the failure of the lung to expand have been chiefly three: (1) The shortening of the trabeculæ of the lung the result of prolonged collapse of the lung combined perhaps with infection (*i.e.*, pulmonary fibrosis), (2) adhesions at the point of junction of visceral and parietal pleuræ and (3) thickened pleura. It is well known, as shown by our experiments upon animals, that a normal lung covered by a normal pleura will expand indefinitely to fill any space within the pleura, provided the thoracic cavity is closed. It is also known that in the human subject a relatively normal lung with nearly a normal pleura will spontaneously expand and obliterate a cavity, even in the presence of an open pneumothorax, the result of a rib resection. Quite different conditions obtain in chronic empyema. Even in cases with simple ovoid cavities (without pockets, etc.), observed with the thoracic cavity widely opened so that any movements of the lung may be seen, the greatest force exerted by the patient in forced expiration is often incapable of expanding the lung in the slightest. There is

therefore a powerful resistance to the expansion of the lung in chronic empyema. It has been clearly shown that the shortening of the trabeculae of the lung is a rare and insignificant factor in this; for the removal of the other factors enumerated allows in the great majority of cases the satisfactory expansion of the lung. We must look therefore to other factors for the failure of the lung to expand, and we find them I think in the adhesions or union between the visceral and parietal pleurae at the margins of the cavity and in the thickened, resistant, inelastic pleura. A cross-section of a chronic empyema cavity will usually have in our experience an oval shape but differing from an exact oval in that one side—the visceral or lung side—is shorter than the parietal. The thickened visceral pleura has, then, become shortened and bears somewhat the same relation to the chest wall and parietal pleura as a cord subtending an arc. It is firmly held by its union with the thickened rigid parietal pleura. So long as this union persists the shortened visceral pleura cannot meet the parietal pleura and therefore the lung cannot expand to obliterate the cavity. That this is very largely the explanation for the failure of the lung to expand is shown by the success of three procedures: (1) The Fowler-Delorme, which removes the visceral pleura, thus removing the cord subtending the arc, (2) the excision of the parietal pleura described by myself,[†] which severs the union between visceral and parietal pleurae and thereby allows the expansion of the lung and (3) the sterilization of the infected pleura which is followed by the absorption of the thickened pleura.

(b) *The Continuance of the Infection.*—Infection is the cause of the thickened pleura, the thickened pleura is, as we have just shown, the cause of the failure of the lung to expand and obliterate the cavity, the persistence of the cavity is most commonly the cause of the continuance of the infection. There is established therefore a vicious cycle which continues until either the cavity is surgically obliterated or the infection overcome. That infection is the fundamental cause for the persistence of chronic empyema was first completely demonstrated by us in 1913; for after the complete sterilization of a chronic empyemic cavity we allowed the sinus to close, leaving within the thorax a large intrapleural cavity. Subsequent cases showed that this experience was not unique and in 1920 we reported 7 cases[‡] in which we succeeded in sterilizing chronic empyemic cavities. In all we closed the sinus, leaving within the thorax an unobliterated cavity; and found that the patients remained well, that the thickened pleura disappeared and the cavities were sooner or later spontaneously obliterated. The cure of the infection will alone therefore result in the cure of chronic empyema; for with the disappearance of the infection the thickened pleura is absorbed, allowing the expansion of the lung and the obliteration of the cavity.

The treatment of chronic empyema to be adequate must consider the above factors. The Estlander and Schede operations are designed to obliterate the cavity by bringing the thoracic wall in contact with the lung. The Fowler-

[†] ANNALS OF SURGERY, July, 1920.

[‡] ANNALS OF SURGERY, July, 1920.

Delorme operation is designed to obliterate the cavity by allowing the lung to expand to meet the thoracic wall. In both groups of procedures the obliteration of the cavity is the primary object, the control of infection a secondary consideration. The excision of the parietal pleura, combined with the Carrel-Dakin treatment as practiced by us, was designed both to aid in the obliteration of the cavity and to control the infection; and it has been shown that complete sterilization of the cavity with closure of the sinus may precede obliteration of the cavity. The simple sterilization of the cavity and the wide exposure of the cavity combined with sterilization (the latter so far as I know first practiced by M. R. Reid in Baltimore and later brilliantly carried out by W. L. Keller) are procedures primarily designed to control the infection, the obliteration of the cavity being the secondary consideration—and occurring spontaneously so soon as the infection is controlled. In a consideration of these various procedures account must be taken of the mortality, of the certainty of cure, of the mutilation and of the resultant functional disability of the lung. Personally we have employed the Estlander or Schede operation in only two cases, for the mortality, the mutilation and the functional disability of the lung have seemed to us great disadvantages. We have made use of three procedures, the simple sterilization of the empyemic cavity with subsequent closure of the sinus; the excision of the parietal pleura combined with sterilization of the cavity and the wide exposure of the cavity by rib division followed by sterilization of the cavity and secondary closure. The two former procedures are applicable in the relatively small simple cavities; the latter in the large complicated cavities. The results we have obtained by the use of these procedures will be given in our summary.

Summary.—From a study of all the foregoing factors we may attempt to outline methods of treatment which in our experience most nearly meet the conditions enumerated in our opening paragraph.

1. Early diagnosis in acute empyema is desirable for failure to make an early diagnosis and institute prompt treatment favors the development of serious complications, increases the mortality and predisposes to prolonged convalescence and chronicity.

2. An early surgical consultation having been obtained, the most careful physical and X-ray examinations should be made for the purpose of determining the presence or absence of complicating conditions. It has been shown that the presence of bronchopneumonia in the lung of the affected or the contra-lateral side, the presence of bilateral empyema, lung abscess, pericarditis, peritonitis, etc., affect profoundly the prognosis and often determine the kind of surgical procedure. The intra-pleural fluid should be examined to determine its character and the kind of infecting organism. It is not clear to us that aspiration drainage has any disadvantages if done without the production of a pneumothorax and under local anæsthesia over simple aspiration, and we can see no good reason for waiting, if a fluid is not purulent but contains many leucocytes and organisms, for frank pus to develop.

3. In infants and young children, in adults very ill with grave toxæmia, and in all cases in which physical and X-ray examinations show or suggest the presence of pneumonia, either lobar or lobular, in the lung of the affected or contra-lateral side or other pulmonary complications, aspiration drainage promptly done under local anæsthesia and without the production of surgical pneumothorax is in our opinion the procedure of choice. Its advantages are that it causes the least possible trauma, it avoids surgical pneumothorax which in the presence of pulmonary complications is a grave condition, and it permits continuous, air-tight, gentle suction drainage and sterilization of the cavity. Its one disadvantage is that the presence of fibrin clots which fail to pass readily through the tube sometimes makes the post-operative management troublesome; yet we can say from a fairly large experience that this difficulty can be overcome, and without the necessity of further operative procedures. It has materially reduced the mortality in the dangerously ill of all age groups, but particularly in infants and young children, as we shall presently show.

4. In adolescents and adults not desperately ill and with empyema localized in the sense that adhesions between visceral and parietal pleuræ have formed of sufficient strength to prevent the ill effects of open surgical pneumothorax, aspiration drainage need not be insisted upon and rib resection may be performed. But if rib resection is performed, provision should be made for immediate continuous air-tight suction drainage. In the past year we have had one fatality due clearly to acute surgical pneumothorax, the result of an open sucking wound following a rib resection.

5. The proper post-operative management of acute empyema is of great importance. Air-tight suction drainage, sterilization of the empyemic cavity, continuous hospital treatment until it has been proven that the empyemic cavity is obliterated and proper pulmonary gymnastics will result in a lowered mortality, in a short convalescence, in a lessened tendency to chronicity and in less functional disability.

Let me conclude this paper with a statement of the results obtained by myself and my associates, Drs. M. R. Reid and B. N. Carter, in the treatment of empyema. The total number of cases treated was 125, of which 83 were acute empyema and 42 chronic empyema. One hundred and twenty-five cases were operated upon with 19 deaths, a mortality of 15 per cent.

An examination of our mortality shows the following:

- 1 age 30, died the day of operation. No autopsy.
- 1 age 49, died the day after operation. Autopsy. Bilateral bronchopneumonia; purulent pericarditis.
- 1 age 5 weeks, died 10 days after operation. Autopsy. Septicæmia. (Proven.)
- 1 age 32, died 3 days after operation. Autopsy. Bilateral bronchopneumonia.
- 1 age 36, died 30 days after operation. Autopsy. Lung abscess opposite side.
- 1 age 42, died ? days after operation. Autopsy. Primary carcinoma of lung.
- 1 age 47, died 21 days after operation. Autopsy. Embolism, infarction, gangrene lung—following repair arteriovenous fistula.

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- 1 age 20, died ? days after operation. Autopsy. Bilateral empyema, bilateral lung abscesses.
- 1 age 1- $\frac{1}{2}$, died 10 days after operation. No autopsy. Symptoms of pulmonary embolism.
- 1 age $\frac{1}{4}$, died 35 days after operation. No autopsy. Bilateral bronchopneumonia.
- 1 age 2, died 30 days after operation. No autopsy. Cause unknown.
- 1 age 2, died 12 days after operation. No autopsy. Cause unknown.
- 1 age 2, died 27 days after operation. No autopsy. Bilateral pneumonia; septicæmia. (Proven)
- 1 age $\frac{3}{4}$, died 61 days after operation. No autopsy. Cause unknown.
- 1 age 23, died ? days after operation. No autopsy. Septicæmia. (Proven)
- 1 age 33, died 4 days after operation. Autopsy. Bilateral bronchopneumonia.
- 1 age $\frac{3}{4}$, died 16 days after operation. No autopsy. Cause unknown.
- 1 age 40, died immediately after operation. No autopsy. Shock following extensive Schede operation.
- 1 age 31, died ? days after operation. No autopsy. Septicæmia; (Proven) acute surgical pneumothorax.

Two deaths in this series (carcinoma of lung; gangrene of lung) should be excluded.

The above data include our total experience. When we compare with them our statistics since we have become interested in the subject we find that our results have vastly improved in at least three directions: (a) In lowering the mortality in all age groups, but especially in children under five. As previously noted, the mortality of the entire series for this group was 24 per cent. In our recent series (15 cases) the mortality has been 6.6 per cent. This reduction in the mortality has been due we believe in large part at least to more careful examination before operation, to the substitution of aspiration drainage with local anæsthesia for rib resection and to more careful post-operative supervision. We are, however, aware that the lowered mortality may in part be due to the less frequent presence of complicating conditions. (b) In preventing the development of chronic empyema. Since we have insisted in the past three years that no patient leave the hospital until he is cured, we have had no instance of chronic empyema develop from an acute empyema which we have treated. This we can say after a careful study of the late results in our cases. The criteria for a cure must be rigid. The lung must be proven by physical and X-ray examinations to have completely expanded, and the cavity therefore completely obliterated and the sinus tract healed. Under these conditions we have never yet observed the recurrence of the condition. (c) In the cure of chronic empyema with a low mortality. In our personal series of 42 cases of chronic empyema there have been 35 cases of non-tuberculous chronic empyema and 7 cases of proven tuberculous empyema. Of the 35 cases of non-tuberculous chronic empyema 30 have been operated upon, the operation consisting of either (1) rib resection and sterilization of the cavity, (2) of excision of the parietal pleura followed by sterilization and (3) of wide exposure of the cavity by rib division, sterilization and secondary suture. Five have not been operated upon, the treatment consisting of the sterilization of the cavity through the

original sinus tract. In these 35 cases there has been no mortality. The results in all are known. Twenty-nine have been healed and are well from 1 to 6 years after operation, 2 are healed and well less than 1 year after operation, 4 are still under treatment in the hospital and will undoubtedly be cured. Our experience is far different in the cases of tuberculous empyema. Of the 7 cases in our series all were operated upon, the operations consisting of rib resection with attempts at sterilization in 5, and extensive Schede operations in 2. Following operation 6 patients recovered; 1 died of shock following a Schede operation. Of the six patients who recovered 1 was living and greatly improved in health 2 years after operation, but continued to have a discharging sinus, 4 are known to have died from 6 months to 2 years after operation and one has not been heard from. In none of these had the sinus healed at the time of death. It would appear therefore that the cure of non-tuberculous chronic empyema is quite possible and with a low mortality; the cure of tuberculous empyema remains a problem which still requires serious study.

EXTERNAL DUODENAL FISTULÆ*

BY RALPH COLP, M.D.

OF NEW YORK, N. Y.

DUODENAL fistulæ may be classified into two varieties, the internal and the external. The internal are by far the more common. Courvoisier and Naunyn¹ collected 384 cases of internal biliary fistulæ of which 108 connected with the duodenum. This type of fistula does not concern us here. The external fistula, the group in which the duodenum is connected to the skin by a sinus tract, may be divided into two classes—those having their origin from the peritoneal portion of the duodenum and those arising from its retro-peritoneal areas. The former occur with greater frequency and usually arise in the first portion of the duodenum, more rarely, the second. These duodenal fistulæ cannot be as rare as one would gather from a review of the literature, for, when the importance of the duodenum is considered surgically, there are ample causes for the appearance of these fistulæ as post-operative complications.

Lilienthal² in 1901 reported the first two cases treated by surgical measures for the relief of this distressing condition, and in 1903, von Cackovic³ was able to collect only six additional cases from the literature, all of which had been treated conservatively and ended fatally. Melchoir,⁴ in 1917, added about 14 additional cases. This report, which is a collective review of 53 reported cases and 8 new ones from the records of Mt. Sinai Hospital, seems to verify to a degree the statement of Palmer,⁵ that "duodenal fistulæ are neither the rare nor the simple, benign affairs that the silence of the professional pen might lead one to conclude." Pannet⁶ (1915) states "that as far as could be ascertained from the writings of the past ten years, a duodenal fistula never healed without surgical aid and if left is invariably fatal, and, moreover, death may be exceedingly rapid."

That duodenal fistulæ are of bad prognostic import has long been recognized. This emphasizes the fact that not only are they serious surgical cases, but if they are to be handled with any degree of success, they must be treated energetically and early, and not when the strength of the patient has been so debilitated by inanition and dehydration that surgical intervention is impossible. External duodenal fistulæ have a mortality greater than any other variety of intestinal fistulæ. This is obvious when the anatomical location and the physiological importance of this structure are carefully considered.

The duodenum receives the gastric contents; into it are emptied the bile, pancreatic secretions, and its own succus entericus. While there is considerable digestive activity in the stomach, its powers of absorption are negligible,

* From the Surgical Service of Dr. A. V. Moschcowitz, Mt. Sinai Hospital, New York.

TABLE I.
Table of Cases of External Duodenal Fistula Cleared from Surgical Literature.

Case	Surgeon	Date	Diagnosis	Operation	Drainage	Appearance of fistula	Treatment	Course	End result
1	Berg, A. A.	1907	Carcinoma of pancreas	Cholecystoduodenostomy	?	5 days P. O.	Ant. gastro-enterostomy, with pyloric occlus. 9 days P. O.	Discharge stopped immediately. Died 67 days P. O. from Ca.	Died.
2	Berg, A. A.		Perforated duodenal ulcer	Suture of perforation	?	7 days P. O.	Post. gastro-enterostomy, suture of fistula, 7 days P. O.	3 days later recurrence Suture unsuccessful 10 days P. O., occlus., pylorus.	Died.
3	*Burgess.		Perforated duodenal ulcer	Drainage of subphrenic abscess	?	Immediate	Suture of duodenum, 5 months P. O.	Cured.	Cured.
4	Clark.	1919	Cholecystitis	Cholecystectomy	Yes	17 days P. O.	Conservative	20 days P. O., fistula healed 12 days P. O., death	Cured.
5	Clark	1919	Cholecystitis	Cholecystectomy	?	3 days P. O.	Jejunostomy 10 days P. O.	Died.	Died.
6	Cheever.	1915	Rupture of duodenum	Duodenorrhaphy	Yes	5 days P. O.	Irrigation of sinus	11 days P. O., fistula healed	Cured.
7	Davis.	1918	Duodeno-ureteral fistula	Duodenorrhaphy	?	4 days P. O.	Conservative	8 days P. O., fistula healed	Cured.
8	Erdman.	1921	Rupture of duodenum	Duodenorrhaphy	Yes	6 days P. O.	Jejunostomy, 8 days P. O.	18 days P. O., fistula closed	Cured.
9	*Esau.		Rupture of duodenum	Incision, lumbar abscess	?	48 days after injury	Jejunostomy, 4 weeks after injury	Fistula discharged for six months	Death.
10	*Fenwick.	1900	Rupture of duodenum	None		42 days after injury	Conservative	3 months later recurrence 75 days P. O., suture, perforation.	Died.
11	Fink.	1905	Cholelithiasis	Cholecystectomy	Tamponade	28 days P. O.	Gastro-enterostomy, suture fistula 35 days P. O.	95 days P. O., discharged	Cured.
12	Hendon.	1919	Cholangitis	Exploratory	Yes	Immediate	Conservative	5 weeks later, healed	Cured.
13	Hinton.	1866	Rupture of duodenum	None		Several months later	Conservative	20 years persistent discharge	Died.
14	Kehr.		Cholecystitis	Cholecystectomy	Tamponade	8 days P. O.	Conservative	13-22 days P. O., healed	Cured.
15	Kehr.		Cholelithiasis	Cholecystectomy	Tamponade	5 days P. O.	Suture, 8 days P. O.	Recurrence, 11 days P. O., healed	Cured.
16	Kehr.		Cholelithiasis	Cholecystectomy	Tamponade	6 days P. O.	Suture, 9 days P. O.	15 days P. O., sutured 3rd time. 17 days P. O., post. gastro-enterostomy	Died.
17	Kehr.		Cholelithiasis	Cholecystectomy	Tamponade	20 days P. O.	Conservative	43 days P. O., healed	Cured.
18	Kehr.		Cholelithiasis	Cholecystectomy	Tamponade	12 days P. O.	Conservative	18 days P. O., healed	Cured.
19	Kelling.	1922	Carcinoma of stomach	Duodenostomy Billroth I	?	12 days P. O.	Jejunostomy, 8 days P. O.	30 days P. O., healed	Cured.
20	*Knags.	1909	Perforated duodenal ulcer	Incision, psoas abscess		Several weeks later	Posterior gastro-enterostomy, pyloric occlus., 3 mos. P. O.	Immed. cessation of discharge	Cured.

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21	*Körte.....	1904	Rupture of duodenum (?)	Suture	Tamponade	60 days P. O.	Suture, perforation. Jejunostomy, 5 wks. Conservative	2 days later, peritonitis	Died.
22	†Kraus.....	1865	Perforated duodenal ulcer	None	Tamponade	?	Conservative	1 mo. after perforation death	Died.
23	†Kraus.....	1901	Cholelithiasis	Cholelithotomy		2 days P. O.	Suture attempted	30 days P. O., death	Died.
24	†Körte.....	1870	Perforated duodenal ulcer	None		90 days after perforation	Conservative	Healed spontaneously, 18 months later, death	Died.
25	†Luneau.....	1870	Cholecystitis	Cholecystectomy		9 days P. O.	Jejunostomy immediate	3 wks. later, fistula healed	Cured.
26	McGuire.....	1910	Carcinoma of stomach	Bilroth I	?	10 days P. O.	Suture, 15 days P. O.	10 days P. O., death	Died.
27	Makras.....	1907	Pyloric tumor	Bilroth I	?	10 days P. O.	Conservative	10 days P. O., death	Died.
28	Makras.....	1907	Tumor of stomach	Bilroth II	Tampon	6 days P. O.	Conservative	30 days P. O., death	Died.
29	Makras.....	1907	Cholecystitis	Cholecystectomy	Tampon	15 days P. O.	Conservative	70 days P. O., fistula healed	Cured.
30	Merz.....	1902	Cholecystitis	Suture, gastro-enterostomy	Yes	?	Conservative	Death	Died.
31	Mayo.....	1904	Perforated duodenal ulcer	Suture	Yes	?	Conservative	Healed	Cured.
32	Mayo.....	1914	Perforated duodenal ulcer	Nephrectomy	?	5 days P. O.	Conservative	14 days P. O., death	Died.
33	Mayo.....	1914	Carcinoma of kidney	Nephrectomy	?	5 days P. O.	Conservative	10 days P. O., death	Died.
34	Mayo.....	1914	Carcinoma of kidney	Nephrectomy	?	5 days P. O.	Conservative	14 days P. O., death	Died.
35	Mayo.....	1914	Nephrolithiasis	Nephrectomy	Tampon	2 days P. O.	Suture, fistula immed.	Uneventful recovery	Cured.
36	Mayo.....	1914	Carcinoma of stomach	Bilroth II	Tampon	12 days P. O.	Conservative	2 mos. P. O., fistula healed	Cured.
37	Neelhor.....	1914	Cholecystitis	Cholecystectomy	Tampon	?	Conservative	7 mos. P. O., fistula healed	Cured.
38	Meyer.....	1920	Cholecystitis	Bilroth II	Yes	8 days P. O.	Conservative	24 days P. O., fistula healed	Cured.
39	Palmer.....	1918	Carcinoma of stomach	Cholecystectomy	Yes	6 days P. O.	Conservative	28 days P. O., fistula healed	Cured.
40	Palmer.....	1914	Cholelithiasis	Duodenostomy	Yes	4 days P. O.	Jejunostomy 8 days P. O.	15 days P. O., fistula healed	Cured.
41	Fannett.....	1914	Perforated duodenal ulcer	Duodenorrhaphy	Yes	2 years P. O.	Suture	Recovery	Cured.
42	*Payr.....	1911	Perforated ulcer	Nephrectomy	?	Feew weeks P. O.	Conservative	0 mos. persistent discharge	Died.
43	*Payr and Shaw	1911	Tuberculosis of kidney	None	Yes	3 days P. O.	Conservative	Healed	Cured.
44	Rigby.....	1911	Perforated duodenal ulcer	Drainage of abscess		2 days after illness	Conservative	9 days P. O., fistula healed	Cured.
45	Rigby.....	1911	Perforated duodenal ulcer	None		2 days after illness	Conservative	Death after 1 month, inanition	Died.
46	†Rimmel.....	1867	Intestinal tuberculosis	None		?	Conservative	Death after 3 weeks, inanition	Died.
47	†Staten.....	1912	Perforated duodenal ulcer	Incision, abscess		5 days P. O.	Suture and gastro-enterostomy	6 days P. O., death	Died.
48	*Telford.....	1913	Perforated duodenal ulcer	Nephrectomy	?	?	Beck's paste. Gastro-enterostomy	9 days P. O., healed	Cured.
49	Thevenard.....	1913	Perforated duodenal ulcer	Duodenorrhaphy	Yes	2 days P. O.	Conservative	8 days P. O., death	Died.
50	Turner.....	1913	Perforated duodenal ulcer	Duodenorrhaphy	Yes	3 days P. O.	Jejunostomy 17 days P. O.	5 days P. O., death	Died.
51	Turner.....	1903	Cholelithiasis	Cholecystectomy	Tampon	10 days P. O.	Conservative	19 days P. O., death	Died.
52	Von Cackovic	1903	Sarcoma of kidney	Nephrectomy		8 months after perforation	Conservative	7 months later, death	Died.
53	†Wagner.....	1906	Perforated duodenal ulcer	None					

TABLE I. (Continued)
Table of Cases of External Duodenal Fistula Gleaned from Surgical Literature.
From the Surgical Services of Mt. Sinai Hospital, 1913-1923.

Case	Surgeon	Date	Diagnosis	Operation	Drainage	Appearance of fistula	Treatment	Course	End result
54	Case No. 672	1913	Cholelithiasis	Cholecystectomy Duodenorrhaphy	Yes	5 days P. O.	Gastro-enterostomy with pyloric occlusion, 7 days P. O.	15 days P. O., death inanition	Died.
55	61-74	1914	Cholelithiasis	Cholecystectomy Duodenotomy	Yes	7 days P. O.	Gastro-enterostomy with pyloric occlusion, 7 days P. O.	8 days P. O., death	Died.
56	60-14	1915	Cholelithiasis	Cholecystectomy	Yes	29 days P. O.	Conservative	43 days P. O., fistula healed	Cured.
57	61-136	1916	Cholelithiasis	Left hepato-duodenotomy	Yes	16 days P. O.	Gastro-enterostomy with pyloric occlusion, 21 days P. O.	2 hours later, death	Died.
58	61-181	1920	Cholelithiasis	Cholecystectomy Duo- denorrhaphy/gastro-en- terostomy with pyloric occlusion [†]	Yes	7 days P. O.	Jejunostomy 14 days P. O.	20 days P. O., death	Died.
59	4-34 60	1921 1922	Cholecystitis Cholecystitis	Cholecystectomy Duodenorrhaphy	? Yes	5 days P. O. ?	Conservative Conservative	4 months P. O., healing 2 months P. O., fistula healed	Cured. Cured.
61	41-8	1923	Abdominal pain	Duodenorrhaphy	Yes	5 days P. O.	Conservative	40 days P. O., death	Died.

* Quoted by Melchior, Ed.

† Quoted by Von Cackovic.

‡ Quoted by Lilienthal.

§ Quoted by Schede.

so with an opening in the duodenum, such as exists in a fistula, not only is there a loss of the intestinal juices, but a loss of practically all food and fluid which has been ingested. Inanition and dehydration soon become marked; in fact, each day makes a material change in the gradual malnutrition of the patient. However, the loss of fluids alone cannot account for the rapid emaciation and debilitation which occurs, for even though the body is supplied sufficiently with fluids, hypodermatically, rectally or intravenously, and some nourishment, admittedly small, is given by nutrient enemata and the addition of glucose to the body fluids, deterioration occurs. There may be several factors partially instrumental in causing the rapid death of these unfortunate individuals. Perhaps not only the loss of the pancreatic ferments and to a less extent, the bile, but the absorption of the various secretory products leaving the duodenum through the open fistulous tract may be responsible. It is well known that pancreatic juice is extremely toxic and it may cause a toxicity incidental to autodigestion which with the absorption of these products causes a general systemic poisoning.

Eisberg ⁷ from his experimental work on intestinal obstruction states that "damaged intestinal tissue is the deciding factor as regards the lethal outcome." Roger and Garnier,⁸ studying the toxins of intestinal obstruction, show that the toxicity of the intestinal mucosa was more than its contents, and that the duodenal mucosa possessed a greater toxicity than the ileum. While the pathological conditions of duodenal fistula and intestinal obstruction are in no way related, there certainly must be some absorption from the necrotic and sloughing walls of the duodenum about the fistula. This may be a contributing element to the toxæmia.

Bearing these various points in mind, Palmer, Cheever ⁹ and Erdman ¹⁰ in their cases have attempted by various means either to absorb the secretions from the fistula as soon as they have been formed, or at least to dilute them by adding water.

Duodenal fistulæ may be caused by a variety of circumstances. They may result secondarily to a traumatic rupture of the duodenum as in the cases of Körte,¹¹ Esau ¹² and Hinton.¹³ Here, due to a late necrosis of the duodenal wall, an abscess resulted which by dissection of the tissues finally ruptured externally, forming a fistula. Before 1900, before the period when ulcers were recognized with the accuracy of present-day methods, it was not uncommon for them to rupture, become walled off as an abscess, and subsequently open externally in a region far afield from their origin. For example, in Forster's ¹⁴ case, where there was a retroperitoneal perforation, the pus ascended along the great vessels and finally became localized in the neck. Although this case never lived to form a fistula, the possibilities were there nevertheless. In the cases of Wagner ¹⁵ and Fenwick ¹⁶ swellings appeared in the inguinal region which after spontaneous rupture soon showed that it bore a connection with the duodenum, and when the individual died several months later from inanition, the autopsy showed a sinus running into the second part of the duodenum retroperitoneally. Rarely these fistulæ

occur even after the suture of perforated ulcers, usually, however, only in those cases in which drainage had been used. Varieties of this type are cited by Graham and Mayo,¹⁷ Pannet, Berg¹⁸ and Turner.¹⁹

Occasionally, they are the direct or indirect consequences of operative interference near the duodenum or upon neighboring organs which have become adherent to it. It is perfectly possible to traumatize the duodenal wall mildly at the time of operation, or to compromise its blood supply by the ligation of vessels essential to its nutrition. This may either escape notice or appear so insignificant as to cause no anxiety. However, this area may become necrotic and slough, subsequently forming the basis for a duodenal fistula. Lilienthal, in his thesis, suggested that the wall might be compromised in dissecting away peritoneal adhesions. Such cases have been recorded, following gall-bladder operations, by Kehr,²⁰ Fink,²¹ Meyer,²² Merck²³ and others. This was the most common cause in this series and was responsible for 23 cases. It may follow either accidental opening of the duodenum, as in case 41-8, or in transduodenotomies, as in the case of Kehr, where the duodenum was opened to extract a stone from the common bile duct. It may result after stomach resection, either after a Billroth No. 1 or 2, as recorded by Melchoir,²⁴ Kelling²⁵ and Makkas.²⁶ Removal of the right kidney may be followed by a fistula as in von Cakovic's case, where the duodenal wall was compromised with a secondary necrosis. In the cases of Davis,²⁷ a ureteroduodenal fistula, a piece of mucous membrane was excised, with a secondary opening of the duodenum. In the patients of Mayo,²⁸ Payr²⁹ and Thevenard,³⁰ the duodenum itself was directly compromised by clamps in an attempt to check blindly the hemorrhage from the renal vessels.

The diagnosis of this condition as a rule is not very difficult. The odor and appearance of the dressings are really sufficient to make one suspect the condition. The dressings may suddenly become wet and smell characteristically of stomach contents. This discharge may be so copious as to completely soak the bed linen and mattress. Should the condition be suspected and occur rather early, and at a time when solid food has not as yet been given, methylene blue by mouth will indicate definitely whether or not there is an opening in the intestinal wall by the characteristic color in the discharge staining the dressings.

The discharge, on examination, may or may not contain bile or pancreatic ferments. Von Cackovic, Lieblein and Hilgenreiner³¹ thought that the presence of bile was usually significant in placing the position of the fistula as below the papilla of Vater, and that the absence of bile might lead one to conclude that the fistula was supra-papillary. This distinction, if so, might aid from a prognostic standpoint, for lesions above the papilla certainly cannot be as serious as those below. However, this is fallacious. The fistulae which follow the Billroth 2 operations usually contain bile, and these are excellent examples of supra-papillary fistulae; besides, under certain conditions there may be antiperistaltic waves in the duodenum, and bile and

pancreatic ferments may be carried retrograde far above the papilla. In the case of Telford and Radley,³² where the perforation was one inch from the pylorus, bile was secreted after the retroperitoneal abscess was opened, and Payr reports that in spite of the absence of bile and pancreatic secretions, in his case, the lesions were infra-papillary.

Not only does the odor and the appearance of the dressings make one suspect the condition, but the appearance of the skin is rather characteristic. Often within a few hours after the appearance of the discharge, it becomes red, swollen, excoriated, and soon shows signs of being digested. This excoriation of the skin may extend with extreme rapidity over the entire abdomen, often to the back, causing the patient excruciating pain and annoyance. This dermatitis may prove a bar to secondary operations.

To differentiate a duodenal from a gastric fistula at times is difficult. The reaction of the secretion is of little aid, because high duodenal fistulæ are usually acid. However, the appearance and time of the appearance of food contents are rather important. In gastric fistulæ, the food particles, digested but little, are recognizable as such and occur soon after ingestion. In duodenal fistulæ they appear more digested and occur a little later. To distinguish duodenal from high jejunal fistulæ is slightly more difficult. If this question should arise, the patient might be given a corn kernel attached to a string to swallow. The distance from the incisor line of the teeth to the kernel in the fistula might then be measured and the question answered. Cushing³³ found this particularly useful in proving that a certain fistula was jejunal in origin. Of course, one may always have recourse to X-ray examinations by the injection of bismuth into the fistulous tract, but these procedures are rarely necessary.

The time of the appearance of the fistula varies. It usually occurs from the fourth to the sixth day, the time at which drainage is either changed or removed. When it is due to a slow necrosing of the duodenum with a separation of the slough, it may occur as late as a month after operation.

The amount of discharge is dependent upon the calibre and tortuosity of the fistula and the food ingested. The discharge varies directly with the diameter of the duodenal opening, and inversely to the tortuosity of the sinus. The fact that some patients may survive for years with a duodenal fistula shows that occasionally it may be quite harmless, but the records of death within a few days after its appearance show the alarming character which these fistulæ may adopt. The prognosis of the fistula depends upon its size and is influenced largely by the physical status of the individual. The operations after which these fistulæ develop as a rule have been long, tedious and difficult. The stamina of the patients has been definitely impaired, and coupled with the great loss of nourishment and the absorption of the intestinal juices, they fall easy prey to intercurrent infections such as pneumonia.

The treatment of external fistulæ is by far the most interesting and important phase of the entire subject, because the diagnosis is usually rather

simple. Like so many other surgical complications, the prophylaxis of this condition is better than its cure. In operating upon or in the vicinity of the duodenum, it is imperative that the wall is not compromised; if it is, it must be carefully and skillfully repaired by sutures.

The majority of cases where fistulæ have resulted have been drained, and the appearance of duodenal contents invariably dates from the removal of the tampon, tube, dam or gauze. Wherever possible, pressure must not be exerted against the suture line by drainage material of any variety. For this undoubtedly not only devitalizes the duodenal wall by pressure, but as Horsley³⁴ has suggested, the lymph which ordinarily aids in sealing the duodenal closure is absorbed by the capillarity of the drain. A reopening of a sutured duodenum after an acute perforation of an ulcer which has not been drained is exceptional. It is rather interesting to note that when gauze as drainage was placed against an open duodenal ulcer, fistula resulted. In a series of 200 cases of perforated duodenal ulcer collected by Struthers,³⁵ the majority of which were treated by simple suture, and if drained, the point of drainage was usually in the pelvis, only three cases of duodenal fistulæ resulted. These three cases in which the perforation was not closed at the time of operation died within a few days from the emaciation and asthenia of a leaking fistula. In case 41-8 the duodenum was sutured very carefully in two layers and a reinforcing layer of omentum sewed over it, and a rubber dam was placed down to the suture. While this drainage may not have been responsible for the breakdown of the suture, it may have been a contributing element. The same occurred in the cases of Cheever and Erdman. There is always a potential danger from peritonitis, either from soiling or subsequent leakage after the intestinal canal has been opened, but this should not be any greater following a duodenotomy with duodenorrhaphy than that following a perforated duodenal ulcer, a gastro-enterostomy or a stomach resection, and a drain is rarely placed to the intestinal suture line in these cases.

Resection operations upon the stomach, especially the Billroth 2, which leaves a free duodenal stump, are always attended by the possibility of duodenal leakage and fistula formation. Kelling³⁶ claimed that these fistulæ were caused in part by a damming back of the duodenal secretions into the blind end and that this increased back pressure caused a breaking strain on the suture line. He therefore advised enterostomy between the loops of a gastro-enterostomy so as to insure proper drainage of the duodenum, and in fifty-three cases in which he used this method, only one fistula resulted. Lewitt³⁷ tried to accomplish the same by suturing the duodenal end into the adjoining jejunal loop in the Polya operation. There is no doubt that these precautionary measures are extremely good, but they materially lengthen an operation which even in skilled hands is rather a long procedure. Köttner³⁸ believed that the danger of duodenal leakage could be avoided by a very careful covering of the duodenal stump with peritoneum and further reinforcing this by sutures against the pancreas, omentum or gall-

bladder. Bier³⁹ recommends a very accurate purse-string suture of the duodenal stump with inversion so that it is completely peritonealized.

There is still another point of prophylactic interest. It is a question of procedure when the duodenum has been injured either through external trauma or torn at the time of operation. Would it be better to perform a gastro-enterostomy with pyloric occlusion in addition to the simple suture of the duodenal wound? The value of this operation is discussed subsequently in the treatment by operation of external duodenal fistulæ. It is rather hard to draw any valuable statistics from the recorded cases of duodenal rupture because the mortality is over 95 per cent. Of course, if the opening is small the suture line may be relied upon with safety. But if the opening is large and the wound must be drained, it might be better policy to divert the gastric current. In speaking of traumatic injuries to the posterior duodenal wall, Summers⁴⁰ strongly recommends this procedure. Guibe,⁴¹ in a collected series of 134 cases of traumatic rupture and contusion of the duodenum, reports 129 deaths and five cases living. These fail to throw any light as to the advisability of operative procedure. An abstract of these five cases of recovery is as follows:

CASE I.—GODWIN, 1905, *Lancet*, vol. ii, p. 1108.—Crushed by wagon wheel, signs reduced to a minimum. Operation at the end of six hours. Rupture of great omentum, rupture of the first part of the jejunum and rupture of the anterior surface of the duodenum near its termination. Closure of the two intestinal wounds, that of the duodenum being treated like a pyloroplasty. Lavage of the peritoneum and drainage. Cured.

CASE II.—HEREZEL, *Hildebrandts Jahrebericht für 1896*, p. 691.—Woman of thirty-six, contusion of her abdomen against the angle of a piano. Jejunum 18–20 cm. from its origin twisted on its axis where there was a tear at the duodeno-jejunal angle. Suture. Cure.

CASE III.—KRANTZ, H. W., 1904. Inaugural Dissertation, Leipzig.—Nineteen years old, crushed by a carriage. Marked shock. Operation one hour later. Tear at the level of the duodeno-jejunal angle with denudation of the serous coat for about 5 cm. Suture. Reunion of serous membrane impossible. Tamponade. Cured.

CASE IV.—MEERWEIN, H., 1908. *Beiträge zur klin. Chirurgie*, Bd. 1.123, pp. 495–517.—Female, fifty years old, slid and fell on corner of a chair. Operation at the end of eight hours. Marked contusion of duodenum. Resection of the contused segments. Closure of both ends. Gastro-enterostomy. Duodeno-enterostomy. Cured.

CASE V.—STEINTHAL, 1908. *Münchener med. Wochenschr.*, pp. 169–170.—Eighteen years old. Hit by carriage, wheels passed over abdomen. Operation twelve hours later. Large tear in the mesocolon and almost complete tear in third portion of the duodenum. Suture. Gastro-enterostomy. Lumbar drainage. Cured in spite of an intestinal obstruction which necessitated a second intervention.

In addition, gastro-enterostomies were performed by six other surgeons in this collected series. A case of Kraske's died of pulmonary abscess. Monyhan's case died three months later from perforation of the duodenum by a Murphy button, which had lodged there from a button gastro-enterostomy. Krantz's case died soon after operation. Makins' case died on the ninth

day. Hagen's case died in thirty-six hours from peritonitis. Schwartz's case died an hour after operation.

The treatment of duodenal fistula is either conservative or operative. If the discharge keeps within normal limits, does not progressively increase, the strength of the patient does not appear to ebb rapidly, and from the nature of the operation it is known that that opening in the duodenum cannot be very large, conservative treatment is to be preferred. For the large percentage of smaller fistulae, especially those which occur after gall-bladder operations, invariably heal if the sinus is dressed and treated with care. There are several essential basic principles in the conservative treatment which must be scrupulously and rigidly followed if hope is entertained of curing the condition. It is of prime importance that the discharge from the opening must be diminished as much as possible. What secretion there is must be rendered harmless, either by diluting it or aspirating it as soon as it is formed. Meanwhile, the skin must be protected from the ravages of digestive action of the intestinal juices, and at the same time the nutrition and water balance of the patient must be carefully maintained. All fluids should be immediately stopped by mouth. This naturally will lessen materially the discharge coming from the fistula, but there still will be the gastric juice and the succus entericus of the duodenum with or without the presence of bile and pancreatic ferments. The secretion of these juices is stimulated by "secretin," which is liberated by the saliva.⁴² If all food and fluid is stopped by mouth, the salivary gland will not be stimulated, and there will be very little reflex flow from the duodenum, liver and pancreas. The secretion of gastric juice is partially controlled by the kind and amount of food ingested, and in a fasting stomach this amount is minimum. The little there is may be neutralized by alkalis given by mouth in frequent and small amounts.

To further inhibit the secretion of these juices some surgeons have given atropine and sodium fluoride, but this as a rule is not well tolerated and is of little value. Palmer and others have given mineral oil by mouth, believing that the fat might have an inhibiting influence on the secretion of gastric juice and, by mechanically coating the fistulous tract, lessen the digestive action of the pancreatic juice on the surrounding tissue.

Although the secretions from the duodenum may be greatly diminished by these various procedures, they cannot be entirely stopped. The treatment of the portion which remains is very important. If it is small in amount it may be neglected. If sufficient in quantity it may be rendered less harmful by diluting it with the addition of fluid introduced into the fistula, or by removing it as soon as formed either by swabs or by suction.

The dilution of the secretion by the addition of fluid was not very successful in the hands of Palmer. He used a drop irrigation of one per cent. sodium fluoride solution for about four days, changing the dressings, but had to discontinue it because the fluid ran around to the back macerating the skin. Cheever was more successful with his method and noticed an

immediate cessation of the destructive processes coincident with a general improvement of the condition. In his case, the sinus was continually irrigated with sterile water for five days and five nights; the outflow being conducted into receptacles by means of banks of rubber tissue kept adherent to the skin of the wound by chloroform. It has also been suggested to keep the patient immersed in a continuous warm bath, but this is usually not very practical. In case 61-103, the secretions were gently wiped away whenever they appeared in the opening of the fistula, the open wound being continually watched by an attending nurse. And although this fistula occurred after a duodenorrhaphy where the opening in the duodenum was moderately large, the fistula healed in fifteen days. Erdman ingeniously employed a continuous suction to keep the sinus clean. He reintroduced the collected secretions through a jejunostomy performed three days after the appearance of the fistula. By this method of continuous aspiration he avoided the excoriation of the skin.

It is of great importance that the area about the wound be protected from the digestive action of the intestinal juices because not only does it cause pain to the patient, but all subsequent operations must be done through an infected field. In the beginning when the skin is comparatively dry, it might be coated with a film of paraffin wax of low melting point applied hot to the skin. If the skin is ulcerated the various protective, non-irritating ointments may be used with beneficial effects.

If the fistula is small, the sinus might be snugly packed. This was used by Henden⁴³ and Kehr very effectively. This is never applicable to large fistulæ and should never be attempted because the mere pressure of the packing, together with the chemical irritation, will cause further sloughing and necrosis.

While the caloric value of the food given may be low, the water balance must be absolutely maintained. Fluids may be given by enemata, Murphy drip, hypodermoclysis or intravenously. Glucose infusions, from 5 to 20 per cent., in addition to supplying water, add a small amount of nourishment. Nutrient enemata, about three a day, may tide the patient over until the fistula has closed, when the frequent feeding of small amounts of selected foods with very little bulk may be instituted.

Recently, Meyer and Einhorn⁴⁴ have reported a case of a rather mild fistula occurring after a very difficult cholecystectomy which persisted for about five months. This fistula finally closed by feeding the patient through a duodenal tube which X-ray proved to have slipped into the jejunum. This no doubt is a very excellent way of maintaining the nourishment of the patient and diminishing the secretions of the fistulous tract, permitting the sinus to heal by granulations. In case 41-8 an attempt was made to pass a duodenal tube beyond the fistulous opening on two occasions without success. While this method may not be useful in the really acute cases, it certainly has a very definite indication where the fistulæ have been of rather a long-standing nature.

If the fistula occurs after an operation in which the duodenum has been purposely opened as in a duodenostomy, or after a Billroth 2, it is reasonable to suppose that due to infection and sloughing the entire extent of the duodenum which has been sutured may open. This is also true after the duodenorrhaphies for rupture of the duodenum or a reopening of recently sutured ulcer perforations of the duodenum. While the operative statistics in these cases are no better at the present time than those treated conservatively, they no doubt could be improved. To begin with, operation must be done early at a time when the patient is not too debilitated from the prolonged effects of drainage from the duodenum, and what is more important, a proper operation must be instituted.

The various operative procedures which may be used are: suture of the duodenal opening, suture of the duodenum with gastro-enterostomy with or without pyloric occlusion, and jejunostomy.

Simple suture of the perforation seems ideal, but it is absolutely useless when the pathology of the fistula is considered. The tissues about the opening in the duodenum are devitalized. The sinus is long, deep, chronically infected, favoring the formation of a dead space. The sutures may seemingly hold for the time being, but the tissues seem to have lost their ability to heal over, and in a few days, aided by the pressure of the duodenal contents, the perforation recurs. The condition is worse now than it was before an attempt was made to better it. Kehr tried suture three times in one case, Berg twice, Makkas and Kraske once, all with the same result—failure. Certainly, suture is worthless when the fistula is a peritoneal one.

Lilienthal (1901) suggested that if the duodenal and gastric secretions be diverted from the recently sutured perforation, the opening might heal. He suggested gastro-enterostomy. This operation without pyloric occlusion for duodenal fistula is worthless.

Kelling's experiment on gastro-enterostomized dogs with normal stomachs has shown that most of the ingested food went through the pylorus and not through the stoma, and after duodenal and jejunal fistulae had been formed, that most of the food came through the former. Delbet⁴⁵ proved the same by suturing the oral end of the upper jejunum into the abdominal wound and the anal end into the stomach. These points have further been proved by the röntgenological studies of Canon and Blake⁴⁶ and the dye experiments of Borsczeky.⁴⁷ In addition to these experimental data, there is the added proof of the unfortunate clinical evidence in the cases of Berg, Cameron,⁴⁸ Fink, Kehr and Telford showing that a simple gastro-enterostomy without pyloric occlusion is useless. With pyloric occlusion, it is theoretically the operation of choice.

In 1903, Berg⁴⁹ advocated this operation for duodenal fistulae, and in 1907, reported a case which had a dry fistula immediately after the operation, and remained dry until death ensued, seventeen days later, from the cachexia of a carcinoma. Knaggs reports a successful secondary operation for a fistula which had been draining for three months. It is interesting

to note that after the Billroth 2 operation which really fulfills all the requirements of a gastro-enterostomy with pyloric occlusion, that duodenal fistulæ develop, probably from the back pressure of the duodenal contents. Makkas and Kelling have reported instances of this after stomach resection.

In case 61-181 (Mt. Sinai Hospital, see table, No. 53), an operation was performed where cholecystoduodenostomy had already been made. After suturing the opening in the duodenum, as a prophylactic measure against the possibility of duodenal leakage, a pyloric occlusion with a button gastro-enterostomy was performed. In spite of this precaution a duodenal fistula developed seven days later. In case 672, a gastrojejunostomy with pyloric occlusion was performed as soon as the fistula developed, but the fistula continued to discharge until the death of the patient seven days later. These two cases are fairly good evidence that this operation does not guarantee the absolute closure of the fistula. Nor does its performance in cases where the duodenum has been opened guarantee a permanent closure. This point should be clearly borne in mind when advocating this operation for traumatic rupture of the duodenum.

In addition, this operation cannot be performed without a certain degree of shock. Although it may be done rapidly with a Murphy button, adhesions must be divided, new paths of infection are probably opened, with the end result that the patient often dies of the operative interference. This was probably the cause of death in case 61-74 and in case 61-136, where the patients died within twenty-four hours after the operation. There are seven instances in which this operation has been performed, and only one case of permanent cure.

Jejunostomy until recently has been very seriously condemned. Körte and Esau employed it four and five weeks after the rupture of the duodenum. Cackovic fourteen days after the fistula had appeared. All the cases terminated fatally, but this would probably have happened with any other procedure. More recently, Kelling, Pannet, Erdman and McGuire⁵⁰ have used it with excellent results. Jejunostomy is an operation which is comparatively simple. It may be performed expeditiously through a new incision without any fear of spreading the infection and with a minimum amount of shock and hemorrhage. It forms a channel which may be used immediately for the introduction of food and fluid. It must be admitted, however, that the gastric section and some of the duodenal juice may still pass through the fistula, but the amount of this secretion may be materially reduced by employing those measures previously mentioned under the head of the conservative treatment. There is very little chance of food introduced through the jejunal opening reappearing through the duodenal fistula if certain precautions are taken. The jejunostomy must be made at a sufficient distance from the duodeno-jejunal angle. And all fluid food introduced should be given slowly and by drip. For example, Kelling introduced 250 c.c. of fluid by drip so that it took one and one-half hours for its absorption. The advisability of reintroducing into the jejunostomy the secretions

obtained from the fistulous opening by aspiration is still problematical. Erdman did it in his case with excellent results. There is no doubt that the body loses something essential to its well being through the loss of bile and pancreatic ferments. Kelling, to compensate for the latter, gave his patient pancreatin through the jejunostomy.

The treatment of retroperitoneal fistulæ at present seems to be confined to those which occur after nephrectomy. Mayo⁵¹ seems to be of the opinion that the cases which develop within a few days after operation should receive immediate surgical intervention, and he cites three cases treated by non-surgical methods which died within fourteen days from inanition. He advises simple suture of the perforation, reinforced by omentum. This operation is performed by mobilization of the duodenum through the abdominal route. Payr reports a successful suture of a fistula developing two years after nephrectomy. Thevenard reports rather an unusual fistula occurring ten years after nephrectomy complicated by signs of a pyloric obstruction. A simple gastro-enterostomy was performed, the lumbar fistula being filled with Beck's bismuth paste, and in nine days the fistula was closed. Küste⁵² and Davis were able to heal their cases of rather small fistulæ in a few days. Retroperitoneal fistulæ seem to follow the rule of peritoneal ones; if large, operative procedure; if small, conservative measures. The number of cases reported are so small that no definite conclusion as to the operative procedure to be employed can be drawn.

The records of Mt. Sinai Hospital of New York show that eight cases of external duodenal fistula have been cared for in its wards up to the present time. A brief report of these cases is herewith presented.

CASES OF EXTERNAL DUODENAL FISTULA FROM THE SURGICAL SERVICES OF MT. SINAI HOSPITAL, NEW YORK

CASE I.—R. L., female, aged sixty-one. No. 41-8. Admitted January 12, 1923. Died March 4, 1923. Diagnosis: Abdominal pain after cholecystectomy. Operation: Exploratory laparotomy. Duodenorrhaphy. Complications: Duodenal fistula, erysipelas of face and back, bronchopneumonia.

History: Epigastric and right upper quadrant pain for three weeks. Two months before admission, cholecystectomy and choledochotomy for acute cholangitis. Had severe attacks of abdominal pain while in the hospital which were controlled only by morphine. Wassermann negative. Physical examination negative except for scar of previous operation.

February 1, 1923, adhesions freed from gall-bladder bed. Common duct free of stones, foramen of Winslow closed. Duodenum mobile, and in lifting it up to palpate the region of papilla, retractor tore a hole in the first portion of the duodenum. Duodenorrhaphy by two layers of chromic catgut, a third suture line bringing over the mesentery and over this the omentum. Drainage. A rubber dam drain down to the duodenum, closure of the wound in layers. Three days post-operative, pain in the wound, tenderness, fullness about the incision. Free drainage of bile. On Murphy drip. Five days post-operative, dressing soaked with bile, skin edges reddened and inflamed. Duodenal fistula suspected. Skin protected with zinc oxide ointment. Six days post-operative, rubber dam drain removed; methylene blue by mouth appeared through the sinus in a very few moments. Reaction

of secretion acid. Fluids stopped by mouth. Wound dressed every four hours by packing. Sixteen days post-operative, packing unsatisfactory. Marked leakage. Attempt to pass duodenal tube, X-ray showed it in stomach. Patient given nutrient enemata. Discharge through fistula slightly less. Twenty days post-operative, rise in temperature with appearance of facial erysipelas. Condition of patient is not satisfactory. Fistula is still discharging a fair amount. Twenty-eight days post-operative, all dressings removed and secretions from fistula removed by gentle sponging as soon as they appeared at the external orifice of the sinus. Erysipelas had spread to back. Twenty-nine days post-operative, an attempt made to reintroduce a duodenal tube, and it was thought that after the feeding of peptonized milk which was given a few ounces at a time, there was no leakage. Patient's condition poor. Thirty-seven days post-operative, duodenal tube discontinued because X-ray showed it to be in the stomach. Semi-solid food given by mouth. Discharge appeared to be less. Patient's condition desperate. Thirty-nine days post-operative, acute otitis media. Forty days post-operative, right lobar pneumonia with death.

Autopsy: Acute purulent bronchopneumonia; chronic adhesive pericarditis; fistula of duodenum between duodenum and sinus tracts; cholecystectomy.

CASE II.—E. W., female, aged sixty. No. 61-103. Admitted May 9, 1922. Discharged June 10, 1922. Diagnosis: Chronic cholecystitis, cholecysto-duodenal fistula. Operation: Cholecystectomy; suture of duodenal fistula. Complications: Duodenal fistula.

History: Indigestion for a period of seven months with anorexia and loss of weight, vomiting for past three months after eating once or twice every three days. Physical examination showed an emaciated woman. Liver just palpable. X-ray showed splanchnoptosis, increased peristalsis of the stomach.

May 10, 1922, right rectus incision; first and second parts of duodenum appear infiltrated and gall-bladder connected with the second portion of the duodenum by fistula. Cholecystectomy. Hole in the duodenum closed by chromic gut sutures, which was difficult because of the infiltration and friability of the tissues. Rubber dam drain down to suture line. Large b. m. drain and two layers of iodoform gauze to gall-bladder bed. First day post-operative, gauze removed. Murphy drip 5 per cent. glucose. Five days post-operative, evidently duodenal leakage, skin black and macerated. Nine days post-operative, possibility of performing gastro-enterostomy with exclusion of the pylorus considered but postponed on account of the severe dermatitis. Fourteen days post-operative, considerable leakage of food through the duodenum, but growing less. Eczema of the skin improved. Twenty days post-operative, duodenal fistula appears closed. Thirty days post-operative, duodenal fistula closed for ten days. Condition of patient excellent. Discharged well.

CASE III.—L. D., female, aged forty. No. 61-181. Admitted September 23, 1920. Died October 21, 1920. Diagnosis: Cholelithiasis. Cholecystenterostomy. Operation: Cholecystectomy and drainage, suture of duodenal fistula. Complications: Duodenal fistula. Secondary operation: Jejunostomy.

History: Thirteen years ago following an acute attack of pain in the right upper quadrant, patient had a cholecystenterostomy performed and remained free from all symptoms for six years. Seven years ago, patient had acute pain in the right upper quadrant which radiated to the back and shoulder and three weeks before admission this was repeated. She had been jaundiced on several occasions. Physical examination showed a palpable oval mass situated in the right upper quadrant, extending below the costal margin, moving with respiration, and apparently attached to liver.

September 29, 1920, cholecystectomy; duodenal closure; button gastro-

jejunostomy with pyloric occlusion. Right rectus incision. Stomach, colon and duodenum densely adherent to liver and to gall-bladder. Gall-bladder thickened and connected with duodenum through fistula. Inspissated bile and pus in gall-bladder. Adhesions free. Cholecystectomy. Stoma in duodenum closed with several purse-string sutures of chromic. Pylorus occluded with No. 4 Pagenstecher double, and button gastro-enterostomy performed, the intestinal and gastric parts of the button held in place by a No. 3 Pagenstecher. Mesocolon sutured to stoma by No. 1 chromic. Drainage, one tube, one rubber dam, two gauze packings to liver bed. Four days post-operative, considerable discharge of bile. Seven days post-operative, discharge markedly increased, evidently a leak from intestinal suture line. Patient vomiting almost continuously. Eight days post-operative, marked excoriation of skin by profuse discharge. Fourteen days post-operative, jejunostomy under nitrous oxide. Left rectus incision; stomach and intestines adherent to abdominal wall about old wound, but in the previous operation not found. Sutures firm. Jejunum opened one foot from duodenojejunal angle. Tube introduced with three purse-strings No. 3 Pagenstecher, and the suture of the peritoneum to the jejunum. Fourteen days post-operative, vomiting has stopped; patient slightly better. Nineteen days post-operative, patient much worse; 300 c.c. of glucose solution intravenously. Twenty days post-operative, 900 c.c. of glucose intravenously. Twenty days post-operative, death.

CASE IV.—M. C., male, aged twenty-seven. No. 41-34. Admitted September 21, 1921. Discharged September 29, 1921. Diagnosis: Healing duodenal fistula. Operation: None. Complications: None.

History: Four months ago, following some gall-bladder operation, patient developed a fistula in his abdominal wound through which food recently ingested passed for a certain period of time and then a constant whitish fluid, occasionally bile-tinged. Physical examination showed a well-nourished male with a three-inch oblique incision across the right upper rectus, at the middle of which there was a discharging sinus, the surrounding skin being irritated and reddened. Methylene blue given by mouth appeared at the sinus, one and one-half minutes after ingestion. X-ray examination unsatisfactory. After nine days in hospital, discharge practically disappeared, and operative interference was deemed inadvisable.

CASE V.—S. W., female, aged thirty-eight. No. 61-136. Admitted June 5, 1916. Died August 6, 1916. Diagnosis: Empyema of gall-bladder. Cholelithiasis. 1. Operation: Cholecystectomy with drainage. Complications: Common duct obstruction. 2. Operation: Left hepato-duodenostomy. Complication: Duodenal fistula. 3. Operation: Gastro-enterostomy with pyloric occlusion.

History: One year ago, pain in the right hypochondrium radiating to back lasting two weeks. One month ago, second attack lasting for two hours. Last attack five weeks ago. Never jaundiced.

Physical examination was negative, except that liver is palpable one inch below the costal margin and the edges are sharp.

June 10, 1916, operation, cholecystectomy for empyema of gall-bladder. Right rectus incision; gall-bladder enlarged and adherent to surrounding structures. Adhesions freed, cystic vessels tied; gall-bladder amputated. Rather severe hemorrhage. Cystic and common duct palpated and found normal. Drainage, one tube to stump and one rubber dam down to lower surface of liver with packing. One day post-operative, slight jaundice. Five days post-operative, jaundice more marked; packing removed. Eleven days post-operative, jaundice intense, stools clay-colored. Twenty-three days post-operative, still discharging bile. Forty-one days post-operative, discharge of bile profuse from sinus. Forty-seven days post-operative, secondary operation. Hepato-duodenostomy for common duct obstruction. Incision through former scar. Adhesions divided, lower part of common duct

obliterated. Probe enters right and left hepatic duct easily. Persistent hemorrhage controlled with difficulty. Smallest calibre tube, two and one-half inches long, into left hepatic duct and inserted into small opening in duodenum and buried by sewing duodenum over it and suturing the duodenum to the under surface of the liver. Drainage: Rubber dam drain to Morrison's pouch. Eleven days post-operative, oozing from wound. Sixteen days post-operative, transfusion; duodenal fistula present. Murphy drip. Nineteen days post-operative, condition worse, retaining very little nourishment. Jaundice still deep. Twenty-one days post-operative, duodenal leakage profuse. Third operation, button gastro-enterostomy and pyloric occlusion and four Pagenstecher sutures. Died two hours later.

CASE VI.—R. R., female, aged (?). No. 60-14. Admitted April 10, 1915. Discharged June 10, 1915. Diagnosis: Common duct obstruction; cholangitis. Operation: Choledochotomy, drainage. Complications: Chronic nephritis, duodenal fistula.

History: In 1909, patient had upper abdominal symptoms, and in 1914, was operated upon for cholelithiasis and acute cholecystitis; cholecystectomy being performed. For four months after this operation she was well. Three months ago she began to have epigastric pain referred to the small of her back without nausea or vomiting. Jaundiced for past four days, with some temperature. Physical examination was negative except for jaundice and scar of previous incision.

April 10, 1915, choledochotomy, drainage of common duct obstruction, cholangitis. Right rectus incision. Adhesions freed from stomach and colon and from liver bed. Common duct found dilated and distended with diameter of one and one-half inches. Tube passed into duodenum, and on withdrawal, a plug of mucus was removed. Tube sewed into common duct. Drainage tube and double packings. Five days post-operative, packings removed. Twenty-nine days post-operative, duodenal fistula evidenced by digestion of skin and tissues and the appearance of methylene blue from the sinus when given by mouth. Forty-three days post-operative, fistula healed. Fifty days post-operative, discharged as well.

CASE VII.—S. D., aged thirty-seven. No. 61-74. Admitted August 7, 1914. Died August 16, 1914. Diagnosis: Acute gangrenous cholecystitis; cholelithiasis. Operation: Cholecystectomy. Duodenorrhaphy. Complications: Duodenal fistula. Secondary operation: Button gastrojejunostomy and pyloric occlusion.

History: For three weeks pain in the right hypochondrium radiating to shoulder. Four days ago became jaundiced; stools not clay-colored. Physical examination showed some rigidity in the right upper rectus. On deep palpation, a round, smooth mass in the region of the liver.

August 8, 1914, operation. Right rectus incision; cholecystectomy. Palpation of stone in retroduodenal part of common bile duct. Duodenotomy. Duodenorrhaphy by two layers of sutures, one of chromic and the second of Pagenstecher. Drainage, one rubber dam and three pieces of packing. Four days post-operative, a profuse, rusty-colored discharge with a foul odor. Six days post-operative, discharge definitely bile-tinged. Seven days post-operative, drainage brownish and foul smelling. Methylene blue by mouth evidenced in wound five minutes after ingestion. Secondary operation. Gastrojejunostomy by button with pyloric occlusion by four Pagenstecher sutures. Eight days post-operative, exitus.

CASE VIII.—M. B., fifty-four years. No. 672. Admitted January 20, 1913. Died April 21, 1913. Diagnosis: Acute gangrenous cholecystitis, cholelithiasis, common duct obstruction. Operation: Cholecystectomy and common duct drainage. Complications: Common duct obstruction. Secondary operation: Secondary common duct drainage. Complications: Duodenal fistula. Third operation: Posterior gastro-enterostomy, button, with pyloric occlusion.

History: For two months, pain in right upper quadrant radiating to shoulder;

jaundiced for past ten days. Physical examination shows mass in upper abdomen, in region of liver, globular, size of coconut.

January 21, 1913, operation. Right rectus incision. Right lobe of liver enlarged four fingers below the costal margin. Gall-bladder thickened. Cholecystectomy. Choledochotomy. Drainage tube sutured into place and gauze to foramen of Winslow, cystic duct and liver bed. Fifteen days post-operative, stools clay-colored, appetite poor. Discharge of bile. Sixty days post-operative, stools still clay-colored. Eighty days post-operative, second operation. Choledochotomy and hepatic duct drainage for common duct obstruction. In separating the adhesions a hole was torn into the duodenum; through it the papilla was explored and dilated, but the probe was not able to pass through the common duct. A duodenorrhaphy was performed with two layers of chromic and Pagenstecher over it. The common duct was opened and a stone removed. A tube placed into the common up into the hepatic duct with iodoform packing above. Rubber dam down to intestinal sutures. Three days post-operative, profuse discharge of bile. Five days post-operative, skin edges rather excoriated. Six days post-operative, mucus discharge and bile from sinus. Methylene blue by mouth appears soon in wound. Seven days post-operative, patient going down hill so rapidly and leakage so profuse that through a left rectus incision, a posterior gastrojejunostomy with button and pyloric occlusion with two reefing Pagenstecher sutures was done. The old tube in common duct was attached to bottle drainage and a rubber dam placed down to the duodenum to conduct any leakage to superficial dressings which were changed whenever necessary. Thirteen days post-operative, condition not good. Leakage still continued. Duodenal contents fed by mouth. Fifteen days post-operative, death.

An analysis of the 61 cases of external duodenal fistulae abstracted in this paper showed 23 to have followed operations upon the gall-bladder, 14 duodenal ulcer, 10 nephrectomy, 6 resections of the stomach, 6 traumatic rupture of the duodenum, 1 carcinoma of the pancreas, and 1 intestinal tuberculosis. In the entire group there was a mortality of 51 per cent. Thirty-six were treated conservatively with a mortality of 47 per cent. Twenty-five were treated by operative procedures, with a mortality of 54 per cent.

Fourteen cases of fistulae which followed simple operations upon the gall-bladder had a general mortality of 15 per cent. Ten of these were treated conservatively with no mortality; 4 were operated upon, 2 successfully.

In 11 cases in which the duodenum was opened either at the time of operation, intentionally or accidentally, or found ruptured from external trauma, there was a mortality of 64 per cent. Eight were operated upon with a mortality of 85 per cent., and the 3 treated conservatively recovered.

The 14 cases which occurred after perforated duodenal ulcer had a general mortality of 64 per cent. Of 9 treated conservatively 7 died, and of 5 treated by operation, 2 succumbed. Ten cases after right nephrectomy had a combined mortality of 40 per cent. Of 6 treated conservatively, 3 recovered. And of the 4 treated by operation, 1 died.

In the fistulae following the Billroth operation the combined mortality

was 50 per cent. Four treated by conservative measures had a mortality of 50 per cent. One of the 2 cases operated upon died.

It is evident from these statistics that the prognosis is always grave, excepting those which follow gall-bladder operations in which the opening of the fistula is invariably small. These cases as a rule do well with conservative treatment. As far as the other cases are concerned, the general mortality is about 50 per cent., both after conservative and operative measures. The figures based on the conservative treatment can probably not be improved, but there is no doubt that the operative mortality can be definitely lowered. To accomplish this, surgical measures must be employed as soon as the fistula has formed and the proper operation must be employed. Simple suture except for retroperitoneal fistulæ must absolutely be abandoned. Gastro-enterostomy with pyloric occlusion with a general mortality of 85 per cent. offers very little hope. Jejunostomy at present has a mortality of about 45 per cent., and from all angles it certainly appears to be the operation of choice, especially if it is combined with the aspiration of the contents of the duodenal fistula.

The author wishes to express his thanks to Dr. E. Beer, Dr. A. A. Berg, Dr. Charles Elsberg, and Dr. A. V. Moschcowitz for permission to report cases of duodenal fistulæ which have occurred on their respective services.

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EXTENSIVE RESECTION OF THE SMALL INTESTINE

REPORT OF RECOVERY AFTER RESECTION OF FIFTEEN FEET OF SMALL
INTESTINE AND HYSTERECTOMY

BY JACOB SARNOFF, M.D.

OF BROOKLYN, N. Y.

BEFORE reporting the case it may not be amiss to discuss certain facts which are of interest and pertain to such problems of resection, namely: 1. The length and function of the small intestine. 2. How much may be resected with safety and how is such loss compensated? 3. What is the proper surgical procedure in a given case and what is the post-operative treatment with special reference to nutrition?

The writer's authority for most of the facts as stated below is that of Rost.*

The length of the small intestine varies from 18 to 26 feet, the average being 19 feet. It is relatively shorter in women as compared to men and relatively longer in children. It is shorter in meat eaters as compared to vegetarians. Japs who are great consumers of rice have relatively longer intestines. For every 100 centimetres of body length there are 387 centimetres of small intestine and 91 centimetres of large intestine.

The small intestine secretes enterokinase which activates trypsin; erepsin which reduces albumoses and peptones to crystalline substances. It also secretes lipase, nuclease, and carbohydrate, splitting enzymes such as lactase. Water is quickly absorbed in the upper part of the small intestine. Carbohydrates are absorbed as monosaccharides, and fats when converted into soluble form as by fat splitting enzymes and bile. Absorption of food is practically completed in the small intestine. The jejunum absorbs more fluid and sugar, the ileum absorbs more proteids and fats. Food in noteworthy amounts will pass into the large intestine only in over-nutrition or catarrhal condition of mucosa, except such food containing detritus and cellulose which is split up by the bacteria in the colon and there absorbed. Consequently those having a fistula of the small intestine are best fed on concentrated food such as chopped meat, and other food free from cellulose.

The large intestine readily absorbs alcohol, about 20 per cent. of sugar and 50 per cent. of water; nutritive enemas containing the above are easily absorbed.

How much may be resected with safety and how is such loss compensated? The most extensive resections reported done successfully were those of V. Brenner, 540 centimetres; Gheden, 534 centimetres; Nigrisili, 520, and Axhausen, 475 centimetres, and Pouchet, 400 centimetres, the length of resection therefore ranging from 13 to 18 feet. These cases recovered from operation, but nearly all died shortly afterward. One-half of the small

* Rost's Surgical Pathological Physiology, published by Blakiston, 1923.

intestine may be removed without endangering life. The removal of 80 per cent. of intestine proves fatal. This proportion applies to animal and man alike.

The ileum is the part most often removed in extensive resection. Resection of jejunum is not much more dangerous than that of ileum. The digestive disturbances that immediately follow extensive resections of small intestine are diarrhœa, loss of weight, bulimia and thirst. The intestine remains sensitive for a long time afterward. Equilibrium is finally established. Compensation takes place in resection of the ileum in the following manner: There occurs an increased gastric secretion and the gastric digestion lasts two hours longer, and the intestinal movements in the jejunum, *i.e.*, above the place of resection, are slowed. Cleavage of chyme progresses further, with the result that twice as much is absorbed in the jejunum as shown by experiments on fistula dogs. It is thus shown that the stomach, duodenum and jejunum substitute for resected ileum. The colon takes no part in the compensatory process as proven by other experiments.

In resection of jejunum there is an increase in pancreatic secretion. The chyme is less digested than before operation and less proteids, carbohydrates and fats are absorbed in the small intestine. The colon compensates for such resection except that it cannot absorb much fat. In such resections carbohydrates are well utilized, proteids less and fat is utilized poorest of all.

The nutrition of patients in extensive resections of the intestine is best sustained by giving abundant amount of carbohydrates; food rich in nitrogen is best supplied by giving chopped meat, animal nitrogen being more easily assimilated than vegetable nitrogen. Diminish the intake of fat, for fat makes the action of digestive juices on proteids more difficult. What little fat is given is best given in the form that is most easily digested and absorbed, such being olive oil, goose fat, and lard. No anatomical change in the form of compensatory enlargement has been demonstrated that might be due to resection. The above facts are of special interest in consideration of the following case report:

CASE.—Perforation of uterus by curette; prolapse of intestine through vagina; extensive tearing of mesentery; laparotomy excision of fifteen feet of small intestine, followed by removal of uterus; Recovery.—M. A. Female, twenty-six years of age, married, private secretary, white, born in U. S. A. Last menstruation, January 15, 1923. March 29, two and a half months later, began spontaneously to have profuse vaginal bleeding, which continued for 5 days. April 4 consulted a physician, who on April 6 emptied the uterus with the resulting uterine perforation with prolapse of the intestine. Immediately following the incident the writer was called by the physician, who stated what had occurred. Patient was seen in consultation 15 minutes later and immediate removal to the United Israel-Zion Hospital was advised. Condition of patient appeared hopeless. Many loops of small intestine lay loosely wrapped in cotton, appearing as long as the ordinary jumping rope. Patient was fully conscious, looked very pale, pulse was 120 and irregular. The abdomen was tender, showing evidences of free fluid. Patient was immediately taken to operating room and prepared vaginally

and abdominally. The protruding intestine was cleansed with saline. Operation began 10 P.M. about one and one-half hours following the curettage. Operation completed 11 P.M., time being one hour.

Midabdominal subumbilical incision four inches long was made, and peritoneum incised. A large amount of free fresh blood was found in the peritoneal cavity. A perforation of the uterus about one inch long was found on the anterior uterine wall about one inch above the level of the internal os. About fifteen feet of intestine passed through this perforation. The mesentery of the small intestine was badly torn. There was profuse bleeding from its edges which were irregular, and had many loose tabs. The right broad ligament was badly torn, being the seat of a large hæmatoma. The peritoneal cavity was walled off as much as possible with lap sponges, and the accumulated blood removed. The intestine which was stripped of its mesentery was resected by applying a pair of intestinal clamps to either end of the loop, one end being close to the ileocecal junction and the other at the lower portion of the jejunum. The loop of intestine was severed by means of cautery. Bleeding from the mesenteric vessels was controlled by sutures and ligatures, utilizing the same to approximate the torn edges up to one inch from the intestinal border. About 40 minutes were consumed in repairing the torn mesentery, conserving as much as possible the blood supply to the remaining intestine, which appeared rather dubious in places. An end-to-end anastomosis was done by an outer sero-muscular layer of continuous Lambert suture of 00 chromic and an inner continuous through-and-through Connell suture.

Because of the large uterine perforation and bleeding, and particularly because of the traumatized broad ligament, a hysterectomy was deemed advisable, which was done rather hurriedly, consuming for the intestinal anastomosis and hysterectomy and abdominal closure twenty minutes. Supravaginal hysterectomy was done in the usual manner by clamp and suture method, leaving in the tubes and ovaries. The cervical stump was cauterized and the raw surface of cervix and broad ligaments peritonealized. Enough of an opening was left at cervical stump, through which was inserted a strip of iodoform gauze into the vagina, draining the pelvis. Cigarette drains were inserted, one into the pelvis and another into the right iliac fossa directed away from the point of anastomosis. The abdominal cavity appeared quite empty because of the removal of almost all of the ileum and part of the jejunum as well as the uterus. During closure of abdominal cavity patient was reacting and straining, but none of its contents protruded from the incision for the above reason.

The abdominal wall was sutured in layers, the peritoneum with a continuous suture of catgut, the fascia with chromic, and skin and fascia with silkworm figure of 8 interrupted, and the skin with silk suture. The abdomen on closure appeared markedly scaphoid, more so on the right side, requiring a good deal of gauze dressings to fill in the concavity, in order to properly apply the adhesive straps.

Condition During Operation.—Anæsthetic: gas, oxygen, with very little ether. Pulse 120 at start, 160 thirty-five minutes later and 120 at the end of the operation after 1500 c.c. of saline were given intravenously.

Pathological Report.—Uterus without adnexa is the size of a fist. The wall is 1 inch in thickness. The inner surface of the uterus appears freshly scraped, a ragged perforation on the anterior wall admits one finger. Intestine measured by means of tape measure is fifteen feet long. It appears to be the small intestine stripped of its mesentery completely, except at either end where about one-half inch of mesentery in width is attached to intestine.

Microscopically, section of the uterus shows the usual findings of pregnancy.

Post-operative Course.—Condition after operation fair. Temperature 99, pulse 120, slowing down to 100 in a few hours. Patient was placed in Fowler's

position, continuous Murphy drip of 2 per cent. glucose and sodium bicarbonate given.

April 7, first day after operation, pulse rose to 130, temperature 102. No vomiting, pain in lower abdomen, some blood-stained vaginal discharge. Voided spontaneously 12 ounces in first 24 hours.

April 8, 2nd day, pulse 130, is weak and irregular at times, temperature 100-101, respirations 30-35, voided 46 ounces. Marked epigastric distress and pain. During stomach lavage about one quart of dark bile stained fluid returned. Patient experienced relief after lavage, which was done 3 to 4 times daily for first week, obtaining the same return after each lavage and followed by great relief of epigastric burning and distress. Patient would beg for such stomach lavage, anticipating the relief that followed. Continuous hypodermoclysis was given for the first two days and then was given twice daily, absorbing for one week 2000-3000 c.c. of normal saline in 24 hours. Harris drip of 2 per cent. glucose and sodium bicarbonate was given at intervals, absorbing about 1000 c.c. in 24 hours.

A soapsuds enema was given followed by good results, returning dark colored fluid, containing fecal matter and some flatus.

April 9, temperature 99-101, pulse 130. Enema given with effectual result, dark brown formed stool of moderate amount. Was given small quantities of water and ice by mouth with no vomiting. Vaginal gauze drain removed. Spontaneous bowel movement.

April 10 and 11, complains of dryness of throat and thirst and severe abdominal pain. Dressing was saturated with serous fluid. Had good bowel movements with and without the aid of an enema, expelling a good deal of flatus. Voids 40-50 ounces daily.

April 12, 6th day post-operative, required 1/6 of morphin for abdominal pain. Felt greatly relieved after the escape of large amount of seropurulent discharge through vagina. Retentive enema of normal saline given in place of Harris drip. Abdominal drains removed, wound appears red and inflamed. Was given hot tea and water by mouth.

April 13, temperature 103, pulse 140, seemed quite emaciated, appears drowsy, has marked epigastric distress. Was given nutritive enema every 3 hours, containing sherry wine 5i peptonized milk 5i and liquid peptonoids 5i.

April 14, condition improved, pulse 120, temperature 101. The nourishment was given by mouth instead of by rectum. Complained of marked diarrhœa, 10 bowel movements in 24 hours. Profuse purulent discharge from abdominal wound and vagina.

April 15, condition much improved, pulse 110, temperature 100, retains fluids well, no epigastric distress, diarrhœa stopped, having only two movements in 24 hours, voiding plenty. Hypodermoclysis and enemas discontinued. Appears to have lost about 25 to 30 pounds, as evidenced by flabby skin, etc., as compared to time of operation.

April 16, condition same, increasing diet, adding egg-nogs, zwieback, and strained gruel.

April 18, condition good, temperature 99, pulse 110, diet increased, adding ice cream, fruit juices, chicken soup. Profuse discharge of pus from wound. No vaginal discharge. A slough, size of pigeon's egg, was removed from the depths of wound, being probably some mesenteric slough. Sutures removed. Suppurating wound is about two inches in length and is almost of same depth; holds 3 to 4 ounces of Dakin's solution with which the wound was irrigated daily for about 8 days.

April 20, discharge is much less after the separation of slough and irrigation with Dakin's solution. Soft diet, adding lamb chops, chicken, and many sweets.

EXTENSIVE RESECTION OF THE SMALL INTESTINE

April 20-30, condition improving daily, temperature striking normal, pulse 100, daily normal bowel movements. Wound appears healthy, granulating, being half of its original size.

May 2, 26th day after operation, patient began to complain of sudden severe abdominal pain; marked visible persistalsis was noticed in left upper abdomen. Loops of intestine could be observed moving slowly toward right up to region of umbilicus, at which time pain was excruciating. Left side of abdomen became markedly distended. Felt nauseated all day. Vomited for the first time since operation; vomitus consisted of undigested food; vomited a few times during the day and the following night. Abdominal pain continued, requiring sedatives. Appeared to suffer from beginning intestinal obstruction probably due to some adhesions forming. Pulse 140, poor quality.

May 3, felt greatly relieved toward noon with the sudden escape of gas and discharge from abdominal wound. On changing of dressing a fecal discharge, simulating chyme, and an escape of gas from upper angle of wound was observed. Evidently a spontaneous enterostomy had occurred with relief of the intestinal obstruction. The seat of the opening was probably in the part of small intestine near the point of anastomosis, or at a place where the blood supply appeared rather questionable at time of operation.

May 4, condition fair. Pulse 140, temperature 100. Profuse fecal discharge from wound having the appearance of mustard. Had two spontaneous bowel movements.

May 5, discharge unchanged. Skin over abdomen red and much irritated from the intestinal discharge. Complains of severe burning of skin; appears very uncomfortable. Skin protected by zinc oxide ointment and frequent change of dressing.

May 6-7, continued to have slight gas pains, which were relieved by the escape of gas and intestinal contents from wound.

May 8-26, condition steadily improving, temperature ranging from 98-99, pulse 100. Has ravenous appetite. Is out of bed in a chair on May 26. Appears as if she gained about 10 or 15 pounds in the past three weeks. Weighs now 105 pounds. An opening about the size of the head of a pin at the upper angle of wound appears to communicate with the intestine.

June 1, the granulating wound is the size of a nickel. There is very slight discharge during the 24 hours. It is of a yellowish color and is odorless. The patient is walking around without discomfort. Daily bowel movements without enema. Marked bulimia, cannot get enough to eat. Eats at frequent intervals, regular diet, drinks two quarts of milk daily, consumes a good deal of ice cream and sweets.

June 7, Patient feels fine; gained two pounds since May 26.

A photograph taken of patient compares favorably with the one she took a short time before operation. Apparently patient is thriving well, getting along with the little intestine she possesses. Abdomen is full, not scaphoid, has a thick layer of adipose tissue. She takes part in making dressings and nursing some of the other patients. Appears perfectly normal and is ready to be discharged.

June 11, intestinal fistula completely closed, abdominal wound healed, except for a slight granulation size of a finger nail. Appetite undiminished, has two bowel movements daily instead of being constipated as before operation.

This case presents the following interesting facts:

1. The extent of the extraordinary damage that was inflicted during the curettage.

2. Quick action was imperative, because of the danger of hemorrhage and infection owing to the nature of the injuries sustained. Because of the extensive trauma and the necessary repair, speedy action was essential in this case, so as to spare her the slim chance of recovery that she might have.

3. Resection of such large amount, fifteen feet of small intestine, being in her case most likely more than 75 per cent. of its entire length, was not a matter of choice but of dire necessity. Likewise hysterectomy seemed advisable, because of the large perforation of uterus and trauma of broad ligament.

4. The post-operative course and treatment. The intravenous of saline 1500 c.c., repeated hypodermoclysis, and proctoclysis continued for ten days tided her through a critical period. Very little absorption took place in the gastro-intestinal tract during this period, as evidenced by gastric dilatation and retention of bilious fluid which required repeated gastric lavage. Such lavage relieved her a great deal and materially helped by comforting patient and eliminating the toxic material accumulated in stomach.

5. No evidence of obstruction appeared until the twenty-sixth day after operation, as proven by the daily bowel movements. The obstruction that then occurred was most likely due to post-operative adhesions.

6. The safety valve, the fecal fistula that then appeared, was most likely at a weakened part of small intestine, near point of anastomosis or at some other portion of the small intestine, where its blood supply was impaired because of the traumatized mesentery. The anastomosis was evidently satisfactory, otherwise there would have developed a fecal fistula much sooner.

7. That the nutrition of patient is well maintained is evidenced by the gain in weight and comfort of patient, which is made possible by feeding at frequent intervals with concentrated food, using a good deal of carbohydrates and proteids, and very little of food containing cellulose or fat.

8. The patient presented the typical symptoms credited to such extensive resections, namely, thirst, bulimia, diarrhoea and loss of weight, and sensitive intestines, all of which have occurred during her first few weeks of her illness. The patient now has established a compensatory equilibrium along the lines described in the resumé of literature.

9. The writer considered it a duty and privilege to report the recovery of this rare case. He could not find in the literature a case of a similar nature, one where resection of fifteen feet of small intestine with hysterectomy, complicated by partial intestinal obstruction and fecal fistula, resulted in recovery.

THE RELATION OF CIRRHOSIS OF MESENTERY AND SUBPERITONEAL LIPOMATOSIS TO ALCOHOL AND WORK

BY SIR JOHN O'CONOR, M.D.

OF BUENOS AIRES, ARGENTINA

IN THE *Lancet*, June 3, 1916, under the first heading I called attention to some peculiar conditions which I had met with in the abdomens of some fatty and alcoholic subjects.

1. *Cirrhosis of the great omentum* with marked induration which at first sight suggested malignant infiltration, but the history, general condition, absence of any suspect primary focus, with coexistence of a visible cirrhotic liver, dispelled with a suspicion, and subsequent microscopic examination of excised specimens demonstrating solely fibrous tissue formation dictated the conclusion that as in hepatic cirrhosis a similar obvious condition may from the same cause occur in the great omentum.

2. *Induration of Bowel Wall and Friability of Adhesions.*—In confirmed alcoholics with or without obesity I have often observed on tying peritoneal adhesions that the ligature tore through in an unexpected manner and often found this accentuated when ligating the meso-appendix. From time to time I have also noted (independent of infection) a cirrhotic condition (dry thickening) of the intestinal walls, particularly marked in cæcum and descending colon, in which on the introduction of sutures there was an unusual tendency for the needle to break through or for the stitches to cut out as they were being knotted.

3. *Indurated Pericolitis.*—Palpable chronic inflammatory thickening of the mesocolon along its line of attachment to the gut, frequently associated with adhesions and evident contraction of the adjoining appendices epiploicæ. These patients always belong to the bibulous class and invariably give an indefinite history of gastro-intestinal torment coupled with subjective symptoms, *e.g.*, the morning mouth, feeling like nothing until resuscitated by the matutinal gin and tonic! vague spasmodic pains with general abdominal discomfort and black excrement, a continuous itis from lips to anus.

I have proved to my own satisfaction that surgery (separation of adhesions) in such cases is an absolute futile procedure.

In a few instances in which the above syndrome was definite the presence of sugar in the urine suggested the probability of similar cirrhosis of pancreatic fat interfering with the functions of the islands of Langerhans.

These forms of cirrhosis I attribute to microbic infection passing from within outwards through the bowel wall, the result of prolonged irritation of the mucous coat from constant saturation with surplus alcohol.

While I miss no opportunity to arraign the abuse of alcohol—abusus non

tollit usum—I wish it to be clearly understood that decades of medical and personal experience have convinced me that as a necessary brake and nerve food in the hurry and scurry of modern urban life there is a necessary self-determinable alcoholic coefficient in the metabolic equation of every rational human adult, and that the most likely victims for microbic attack, cancer and the asylum are ascetic abstainers and suicidal toppers.

Quite recently I had a further opportunity for demonstrating a well marked instance of cirrhosis of the great omentum in a man aged fifty-one on whom I was operating (assisted by my colleague, Dr. S. Almond) for appendicitis and in whom there was a positive history of steady indulgence in whisky for many years. The lower portion of the great omentum presented a contracted red appearance, its free margin was obviously thickened and when grasped between the fingers felt like a large fold of hard fibrous tissue. There was nothing further to note beyond an unusually fatty condition of the meso-appendix and an excess of properitoneal and parietal fat. As the liver was out of range of inspection, its appearance could not be noted, but on palpation its lower border did not lack in consistency.

By peculiar coincidence a few days later I met by accident the most supreme case of cirrhosis of the omentum which I have ever seen, combined with considerable pericolic induration, and in which for some moments it was found difficult to exclude general peritoneal cancer; the patient was a campman, and when I saw him a few months ago—twelve years after operation—he was looking the emblem of health with a complexion that would do credit to a rose garden.

Puzzle though it may be to science both of these gentlemen went through operation (appendectomy) without turning a hair, and convalescence followed, without a move in temperature or pulse. I have frequently observed that the sturdy (not putty) type of Anglo-Saxon of full habit of body who takes regular outdoor exercise of a strenuous kind and who never fails to make same the excuse for some extra rounds of whiskies (plus a few gins by way of antidote) stands operation extraordinarily well. In the chloroform days I more than once heard my veteran chloroformist exclaim, as a prelude to some tongue dragging or artificial respiration, "These damn teetotallers always let me down;" his absolute *bête noire* was the worn-to-the-woof "dry" athlete.

4. *Fat Blocked Abdomens*.—In obese females, apart from the common parietal form of Dercum's disease which if undetected may readily lead to an erroneous intra-abdominal diagnosis, my power of perception has been frequently extended to explain, much less treat, the cause of ill-defined spasmodic pains of a dragging or colicky nature commonly emphasized in the left abdomen in which detail revision failed to find any organic lesion, not even a suspicion of varicocele of left annexa.

After the whole litany of science has become exhausted one empirically prescribes a modified dietary and some daily lubricant, the patient seems temporarily to experience relief but sooner or later returns with "I am as bad as ever." Another gruelling examination ensues, including X-rays of

everything abdominal, the hands and eyes are made to scrutinize every fold and crevice, all the secretions, excepting endocrinic are duly tested, result nil, mutual hopeless dissatisfaction ensues which, by the way, only just provides one chink for salvation—exploratory operation.

On opening the abdomen inches of parietal fat discomfit the operator, peritoneal adipose deposits then loom into perspective, bulging cushions of retroperitoneal blubber next obfuscate the vista, at last, when internal palpation commences, anvils of fat, huge appendices epiploicæ, keep continually bobbing up and getting in one's way. By the time a negative assize has been concluded one begins to feel partial-like to those who on extreme occasion fortify themselves with a stiff whisky and soda before tackling the super-problem, how on earth to close the gap in such a drum. I confess that I have often been redeemed by interrupted through-and-through sutures of silk rope introduced by a crowbar of a Doyen needle.

Apart from the superficial tenderness invariably hyper-complained of when one handles the impossible belly of the corpulent female, the size of some of these epiploic tufts suggests that the dragging of such weights on the bowel wall may cause discomfort, particularly when the colon becomes ballooned with fæces and gas. On two occasions I was tempted to undertake excision of these appendages, but found the job so irksome the more I remove the more seemed to spring up that in each I eventually laid down tools.

It seems a strange paradox that ladies who if their pet dog does not get his morning run or favorite horse his gallop raise an awful dust, yet remain so hypnotized in the snobbery of their trans-rhesian ascent as not to have the gumption to apply similar stimulation to their own big gut. In nature there is no greater comedy than to behold an image in wax or a unit of fat leading her Anubis by a string up and down the pavement in front of her hall door until he relieves himself while she with envious glances pines for some dynamite pill, petroleum well, or the next world to achieve the same object.

The man or woman who does not regularly experience the exhilarating sensation derived from outdoor work or exercise robs himself or herself of one of the two pleasures which to the ordinary mortal make this life livable.

The treatment which I now adopt and find most applicable for such bodies is a rigid daily dietary for one to three months of two litres of milk, tea or coffee, two eggs, some green vegetables and fruit with a teaspoonful of sulphate of soda in a claret glass of hot water in the early morning. For ladies in the prime a special dispensation is granted—once a week—in order that they may do justice to the traditional functions inspired by the legend of *Saturday night*.

If an adipose condition has existed from birth or is hereditary, I prescribe a tablet of one grain of thyroid extract to be taken with each meal.

Afterwards when some stones of fat have been consumed the patient is placed on a permanent diet in which fat carbohydrates and alcohol are reduced to a combustible limit; this is supplemented by what is to many of these people

a new regime, *viz.*, a regular system of morning housework, including—what is an excellent preventive of excessive embonpoint—polishing and scrubbing floors, followed by a brisk walk to the market and grocer's before the midday meal. After the morning floors are off I enjoin physical culture in the open air, weeding, hoeing and raking the garden.

The moral, the only way to keep an old horse from getting stiff is to keep him working, applies with equal if not greater force to the human being.

I have seen numerous instances of active men retire from work in this country in the plenitude of their business energy with a fortune or pension sufficient to live "at ease" at home. The majority found "*rest*" within five years.

I am convinced that a human machine in full activity which has for years been geared up to the strain of certain conditions if indefinitely thrown out of action has a strong tendency "to cease to exist;" in other words, the body collapses with the mind which is the spark plug of the concern.

INTESTINAL OBSTRUCTION*

AN EXPERIMENTAL STUDY OF THE THERAPEUTIC VALUE OF THE
ADMINISTRATION OF SODIUM CHLORIDE

By GLOVER H. COPHER, M.D.

AND

BARNEY BROOKS, M.D.

OF ST. LOUIS, Mo.

HADEN and Orr¹ have recently published an experimental study of intestinal obstruction, from which study these investigators reached the conclusion that there was definite relationship between the intoxication and the sodium chloride content of the blood. These investigators are furthermore of the opinion that the administration of sodium chloride serves to prevent intoxication on account of its property to react with the toxic substance and destroy its toxicity.

The experiments of Whipple² *et al.*, have shown that in the intoxication of intestinal obstruction there is marked rise of the non-coagulable nitrogen of the blood. Haden and Orr confirmed this finding and observed that there was a coincident fall in the blood chlorides. They show furthermore that the marked rise in non-coagulable nitrogen can be prevented by the administration of sodium chloride in sufficient quantities to prevent the fall in chlorides of the blood. They conjecture that the rise in NPN is due to protein destruction by the action of the toxic substance and that the fact that administration of chlorides prevents the increase in NPN is evidence that the toxin is neutralized by the sodium chloride. The supposed reaction which takes place is stated by them to be: $X + NaCl + H_2CO_3 = XHCl + NaHCO_3$. In this reaction the toxin is represented by X. Further evidence of this reaction was their observation that the CO_2 combining power of the blood rose with the depletion of the chlorides. From their experiments the authors conclude that administration of chlorides has definite curative value in the treatment of intestinal obstruction.

A careful analysis of these experiments shows that the blood findings observed by the authors were more noticeable in high intestinal obstruction and most marked in pyloric obstruction. It would seem, therefore, that these investigators might be confusing "intestinal obstruction" and "pyloric obstruction." For the purpose of clearing up this point the following experiments were carried out:

Dogs were used as experimental animals. All operations were done under complete surgical anæsthesia. Every effort was made to prevent pain and suffering of the animals. Animals not dying as a result of the experi-

*From the Department of Surgery, Washington University School of Medicine, Saint Louis.

mental procedure were sacrificed by administration of chloroform. Only one experiment of each group will be described. The experiments were repeated often enough to convince us of the constancy of the findings noted.

Experiment No. 1, May 25, 1923.—Dog anesthetized with ether. Abdomen opened. Jejunum sectioned near proximal end. Distal stump inverted. Ileum sectioned approximately 60 cm. distal to previous section of jejunum. The proximal stump inverted. The distal stump was united by end-to-end suture to the proximal stump of the sectioned jejunum. Abdomen closed.

This operative procedure resulted in an isolation and obstruction of 60 cm. of the small intestine. The continuity of the intestinal tract was reestablished. The animal was fed on a diet of table scraps.

June 5.—After operation the animal promptly recovered from the effects of the operative procedure and showed very little evidence of intoxication until 10 days after operation, at which time the animal was very drowsy and failed to eat. On the 11th post-operative day the animal was clearly quite sick. A specimen of blood was taken, and the blood chlorides and non-protein nitrogen were determined. Blood chlorides 418 mg. per 100 c.c. NPN 40 mg. per 100 c.c.

June 8.—Animal died. Autopsy showed slight increase in free fluid in peritoneum. No peritonitis. The isolated loop was not perforated. It was distended. The loop contained approximately 500 c.c. of a thin foul smelling material. A large amount of previous experimental work by one of us has demonstrated that this fluid is so extremely toxic that $\frac{1}{2}$ to 5 c.c. will kill a dog in 3 to 5 hours if given intravenously or intraperitoneally.

This experiment demonstrates that an obstruction of a loop of intestine without obstruction of the duodenum may exist for a period of eleven days and develop marked manifestations of toxæmia and accumulate within the lumen of the obstructed bowel a large amount of very toxic substance without there being any appreciable decrease in the blood chlorides or increase in the blood non-protein nitrogen.

Experiment No. 2, April 28, 1923.—Dog anesthetized with ether. Abdomen opened. Isolation obstruction of a loop of jejunum and ileum 85 cm. long. Reestablishment of continuity of intestinal tract as in experiment No. 1.

May 10.—Thirteen days after operation, animal moribund, sacrificed. No peritonitis. Isolated obstructed loop distended with 1450 c.c. of a thin foul smelling fluid.

Ten experiments were carried for determining the minimal lethal dose of this toxic fluid if it were given intravenously to normal dogs. In four experiments it was found that $\frac{1}{2}$ c.c. of the toxic fluid per kilo of body weight of the animal injected was fatal in 3 to 5 hours.

This experiment was for the purpose of obtaining the toxic contents of an obstructed loop of intestine and determining the minimal lethal dose of this toxic fluid. The following experiments were all carried out with this standardized toxic fluid.

Experiment No. 3, May 14, 1923.—Dog weighing 6.6 K., blood chlorides 501 mg. per 100 c.c., anesthetized. The external jugular vein was exposed. Three c.c. of the standard toxic fluid injected into the jugular vein.

Four-fifty P.M. Two and one half hours after injection. Animal vomiting.

INTESTINAL OBSTRUCTION

Fluid stools. Typical picture of intense intoxication. Specimen of blood taken. Blood chlorides 500 mg. per 100 c.c.

Five P.M. Animal died. Autopsy showed intense hemorrhagic enteritis of duodenum and jejunum.

This experiment shows that an animal may die from the effects of the intravenous injection of the minimal lethal dose of the contents of an obstructed loop of intestine without any decrease in the blood chlorides.

Experiment No. 4, May 12, 1923.—Dog, wt. 4.5 K. Intravenous injection of a mixture of 2 c.c. of standard toxic loop content and 5 c.c. of a saturated aqueous solution of sodium chloride. The animal developed all the manifestations of severe intoxication and died four hours after injection. Autopsy showed intense hemorrhagic enteritis of the duodenum and jejunum.

This experiment shows that the toxic properties of the content of an obstructed loop of intestine are not decreased by the addition of sodium chloride.

Experiment No. 5, May 13, 1923.—Dog, wt. 15 K. Anesthetized with ether. At 7:30 P.M. administration of normal saline solution was begun. The solution was given subcutaneously, intraperitoneally, and intravenously. Immediately after the administration of the normal sodium chloride was started the animal received 5 c.c. of the standard toxic loop content. The normal saline solution was continuously given. The animal developed the typical manifestations of acute intoxication and died 3 hours and 20 minutes after the injection of the toxic loop content. During the period elapsing between the injection of the toxic loop content the animal received 3000 c.c. of normal sodium chloride solution. Autopsy showed the characteristic pathologic lesions.

This experiment shows that there is no appreciable curative value of the administration of large quantities of sodium chloride solution in the intoxication which follows intravenous injection of the toxic content of an obstructed loop of intestine.

Discussion. Intestinal obstruction is a condition in which the outcome is so often fatal that surgeons are ready to try any method which offers a possibility of relief. In perhaps no other surgical condition are there more available experimental methods to test the value of any method suggested. The experimental work of Murphy and Vincent,⁵ Whipple, Stone and Bernheim,⁴ Murphy and Brooks,⁸ Dragstedt, Moorehead and Bureky,⁶ and others, have established fundamental principles which make it possible to test the value of any curative method suggested. Furthermore, these principles already established are such that the possibility of a method for the relief of that intoxication which has already been established is remote.

The cause of the symptoms and death from mechanical obstruction of the intestine is the formation in the obstructed intestine of a powerfully toxic substance and the subsequent absorption of this toxic substance into the circulation. There are two independent processes concerned, the production of the toxin and the absorption of the toxin. For the intoxication it is obvious that both of these processes must operate.

It is not the purpose of this paper to discuss the controversy which has

arisen as to the manner of the production of the toxin. Whipple⁷ has believed it to arise as a perversion of secretion of the mucous membrane. Murphy and Brooks⁸ believed it to be due to the splitting of proteins by unusual bacterial activity. It suffices to state here that mechanical obstruction of the lumen of the intestine always leads to the formation in the lumen of the obstructed gut of a powerfully toxic material which is not present in the lumen of normal bowel. It is obvious, therefore, that any curative method as it concerns the production of the toxin must accomplish a relief of the obstruction.

As regards the absorption of the toxin, there are two independent factors to be considered, the prevention of further absorption of the toxin and the possibility of neutralizing the effects of that which has already been absorbed.

The most fundamental fact concerning the process of actual absorption of the toxin into the circulation is that established by Hartwell and Hoguet,⁸ and Murphy and Brooks, who have shown that it is not absorbed by a normal mucosa and that any process which damages the mucosa leads to the absorption of the toxic loop content. The process most often concerned in promoting absorption of the toxin is the interference with blood supply of the obstructed loop of gut by strangulation or distention. It was pointed out by Brooks⁹ that an experimental intestinal obstruction could be produced in which an animal would live for as much as 21 days with as much as 800 times the lethal dose of toxin in the obstructed loop if strangulation or marked distention did not occur. Any curative method, therefore, which has as its object the prevention of further absorption of the toxin, must be one which removes the toxic substance from the obstructed intestine, removes the intestine with the damaged mucosa, or institutes measures which would make the toxin innocuous if absorbed. To get the toxic substance out of a loop of obstructed gut is impossible. If a loop contained 1000 c.c. and 990 c.c. were removed the remaining 10 c.c. would undoubtedly be a lethal dose. Experimentally a loop of intestine cannot be washed free of toxin; the potency of the toxin is so great that many times the lethal dose may be entangled in the depths of the intestinal glands. This fact probably accounts for the conclusion of Whipple that the toxin arises in the cells of the mucosa. The removal of damaged mucosa in intestinal obstruction is imperative if this damage has been sufficiently great, as in a strangulated hernia with gangrenous bowel. The institution of measures which would render the toxin absorbed innocuous is the principle under investigation in this study.

There are certain facts which have been established by experiment which make it improbable that the toxin can be neutralized after it has entered the circulation. Whipple has shown that the toxin rapidly disappears from the blood stream after intravenous injection. Although the toxin has not been recovered from any of the body tissues, there is experimental evidence that the toxin is rapidly fixed by the body tissues. Werelius¹⁰ believes that death in high intestinal obstruction is due to liver insufficiency. It would seem therefore that after absorption the toxin reacts with some body tissue and

irreparable damage is done, and that after a certain dose has been absorbed no possibility of relief of the intoxication is possible.

The only hope therefore of establishing a method for neutralization of the toxin absorbed from an obstructed loop of intestine is that this method must introduce some factor in the circulation which will react with the toxin to destroy it before it reaches the tissue. The use of sodium chloride as proposed by Haden and Orr was believed by them to be such a method. The experiments described in this paper do not confirm this belief.

The explanation of the different conclusions reached in this paper and those of Haden and Orr is probably due to a difference in the experimental methods employed. The experiments described in this paper were carried out in such a manner that the study was limited to the intoxication of intestinal obstruction without pyloric obstruction. We believe these should be considered independent processes, although clinically obstruction of the intestine must of necessity be more or less complicated by pyloric obstruction, accordingly as the site of obstruction of the intestine is high or low. Obstruction of the jejunum obviously produces greater and more rapidly developing stasis in the duodenum and, therefore, pyloric obstruction, than obstruction of the terminal ileum.

Further evidence that the reduction of blood chlorides is the result of pyloric obstruction has been obtained by Claussen of the St. Louis Children's Hospital from the determination of the blood chlorides in four cases of congenital pyloric stenosis. It has been found that these cases showed a marked reduction of blood chlorides. Further evidence that blood chlorides are not always reduced in intestinal obstruction was obtained in a case of complete obstruction of the terminal ileum which had existed for forty-eight hours and in which there was marked manifestation of intoxication. In this instance the blood chlorides were normal.

The clinical importance of these experiments is the same as that of all previous experimental studies. It shows that the primary object to be sought in the treatment of intestinal obstruction is early recognition of the condition and immediate institution of surgical treatment. If this treatment can be instituted before the patient has absorbed a lethal dose and it is possible to prevent further production or absorption of the toxin, the patient's life will be saved. If the lethal dose of toxin has already passed into the circulation, there is as yet no known method of cure.

CONCLUSIONS

1. Experimental animals may live for as much as two weeks with closed isolated loops of intestine.
2. These closed loops contain large quantities of toxic fluid, sometimes several hundred times enough toxin to kill a dog of equal weight.
3. Intravenous injection of this toxin causes death in healthy dogs in a few hours.

4. Death may occur without any decrease in the blood chlorides.
5. Administration of NaCl in large quantities does not influence the manifestations of intoxication after intravenous injection of toxin.
6. The factors which influence absorption of toxin are of much greater importance in the cure of intestinal obstruction than the factors of production of toxin. When a patient has gotten a certain dose in the circulation, there is no known method by which the damage done can be alleviated.

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MALIGNANT TUMORS OF THE TESTICLE IN CHILDREN*

By ADOLPH A. KUTZMANN, M.D.

AND

THOMAS E. GIBSON, M.D.

OF SAN FRANCISCO, CALIF.

PATHOLOGICAL REPORT BY WM. A. PERKINS, M. D., SAN FRANCISCO, CALIF.

THE comparative rarity of malignant tumors of the testicle in children and the extent and size of the metastases found in a recent case prompt the following report:

E. C., a boy of ten years, entered the hospital with the complaint: (1) pain in the left side of the chest, (2) cough; (3) malaise and weakness. The family history was negative except that the maternal grandfather had died of "heart trouble," and the maternal great grandmother had died of uterine carcinoma. In the past history we find that the patient was a full term normal baby and had a normal development. He had measles at the age of 6 years, influenza at the age of 7 years (a light attack) and mumps and smallpox 1 year before entry. Under accidents and operations it is noted that the patient had a tonsillectomy one and one-half years prior to entry; also that about six months ago he was struck in the scrotum with a rock at which time the mother states that a tumor was found in the left side of the scrotum; she does not know, however, whether the tumor might not have been present prior to the accident. This tumor grew slowly in size and finally was operated on 5 months before entry. The mother states that she does not know what was found at operation but thinks that it was a hard solid tumor of the left testicle.† Two or three weeks ago the parents noted that a hard nodule had recurred at the site of the operation.

The present illness, according to the parents, began 5 weeks prior to entry, at which time the mother says the patient "caught a cold" and developed a fever, cough, dyspnea and malaise. There was no expectoration or pain in the chest. It was found that the patient rested most comfortably when he lay or slept on the left side. The fever and cough disappeared in three days and the patient became well enough to return to school. He continued, however, to have a more or less tired feeling and a little dyspnea, especially on exertion. These symptoms gradually increased until it was noticed that he was unable to play with other children and finally had difficulty even in getting about. A few days before entry the condition became so severe that he was taken to a physician, who made a diagnosis of fluid in the chest and referred the patient to the University Clinic. For a day prior to entry the patient had had to remain in bed because of dyspnea and weakness. For a few days prior to entry he had had considerable pain in the left chest, especially posteriorly, from which some relief could be obtained by lying on the left side. The mother says that the patient has been losing weight but does not know how much.

Physical examination showed a markedly anemic and emaciated boy of ten years, lying in bed on his left side, dyspneic, using all accessory muscles of respiration, and with an anxious expression on his face. The superficial lymph-

*From the Department of Pediatrics and Department of Pathology, University of California Medical School.

† Attempts to communicate with the surgeon who performed operation were unsuccessful, so that it is not known what was found at operation.

nodes were negative. Eyes, ears, nose and mouth were negative. The chest was quite asymmetrical, bulging on the left side and somewhat flattened on the right. There was some retraction of the right supra- and infra-clavicular fossae and the left supra-clavicular fossa. The inter-costal spaces on the left were slightly bulging. There was no movement of the left chest with respiration either anteriorly or posteriorly. The right side was somewhat hypermobile. The thorax in general showed marked emaciation. *Lungs*, there was flatness over the entire left chest both anteriorly and posteriorly. This extended to just beyond the right border of the sternum while below it was continuous with dullness beneath both costal margins. Over this area there was absence of breath sounds, tactile fremitus, whispered voice, etc. On the right side there was an area of dullness which extended to just beyond the right nipple line, probably the area of cardiac dullness. The remainder of the right side anteriorly and posteriorly was hyper-resonant. An occasional crepitant r  le could be heard at the left top, both anteriorly and posteriorly. D'Espine's sign was positive down to the eighth dorsal vertebra; Grocco's triangle was percussed in the lower right back. Heart showed an outline of cardiac dullness as noted above. Pulsations were seen in the 3rd, 4th, 5th, and 6th right interspaces. The sounds were regular and of good quality. No murmurs were heard. The blood-pressure was 95/60. Abdomen upon entry was level and symmetrical, but somewhat rigid. Abdominal respiration was marked. There was an area of dullness and tenderness across the upper abdomen. The liver was easily felt; it was firm and tender. The spleen was not definitely palpable. The kidneys were not felt. The abdominal examination was not satisfactory because of the rigidity. *Genitalia*, the right testis was partially descended. The left scrotum showed the scar of the previous operation. Buried in the scar could be felt a small firm nodule. No epididymis or vas was felt on this side. The remainder of the physical examination was irrelevant.

Course.—The left chest was tapped and 750 c.c. of hemorrhagic fluid removed. The patient felt much better; his dyspnoea seemed somewhat less. The following day 400 c.c. more of the hemorrhagic fluid were removed. These two tapplings seemed to relieve the abdominal spasticity making palpation easier. A large firm tumor could now be felt occupying practically the entire left flank and extending up under the left costal margin. It was rather firmly fixed and did not move with respiration. Extending down from under the costal margin and lying upon this mass was the spleen which was now palpable. The patient continued to go down hill; the dyspnoea became worse in spite of repeated tapplings. Each tapping always yielded from 350 to 400 c.c. of bloody fluid. The dyspnoea became so severe that the patient had to be kept under the influence of opiates. The respirations varied between 30 and 40 per minute. The patient died fifteen days after entry.

Laboratory data: Blood: H  moglobin, 80 per cent. (acid h  matine); red blood cells, 4,990,000; white blood cells, 19,000. Differential-neutrophiles, 50 per cent.; small mononuclears, 40 per cent.; large mononuclears and transitionals, 10 per cent.

Urine: Amber; acid; 1.020; albumin, faintest possible trace; sugar none; microscopic, red blood cells, none; white blood cells, occasional; epithelial cells, occasional; casts, occasional, finely granular.

Stool: Negative.

Von Pirquet: (Bovine and human) negative.

Nose and Throat Cultures: Staphylococcus albus, diphtheroids, micrococcus, catarrhalis.

Blood Wassermann: Negative with two antigens.

Pleural Fluid: Markedly hemorrhagic with the formation of fibrin shreds on standing; specific gravity—1.018; cell count: Red blood cells, 176,000; h  moglobin, 10 per cent., (acid h  matine); white blood cells, 2,400; differential-neutrophiles,

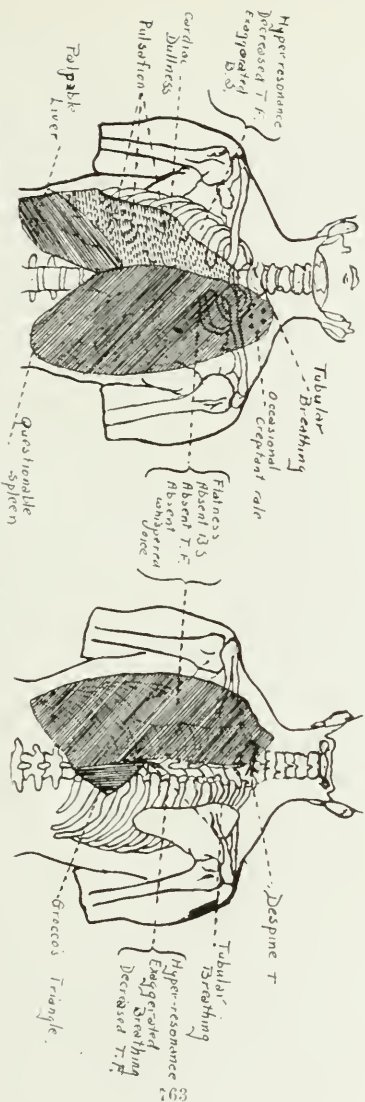


FIG. 1.—Showing physical findings. Note the complete involvement of left side with the marked displacement of the heart to the right.

13 per cent.; small mononuclears, 85 per cent.; large mononuclears, 2 per cent.; when red blood cells were centrifuged down, a straw-colored supernatant fluid remained; Rivalta test—heavy cloud of albumin; Esbach, 1.3 per cent., smear of sediment (Wright stain) showed numerous degenerated and polychromatic red blood cells, some neutrophils and large mononuclears that were coarsely granular and



FIG. 2.—Rontgenogram taken two weeks before death, showing encroachment on left chest with heart pushed over to right.

vacuolated, no tumor cells or mitotic figures; acid fast stain, (antiformin) negative for tubercle bacilli; cultures, sterile; guinea pig inoculation, negative.

Phthalein Test (intramuscular)

1st hour	35%
2nd hour	25%
<hr/>	
Total	60%

X ray Reports: Fluoroscopy and chest plate, whole left lung gray, obscuring the heart outline. Mediastinal contents pushed to the right. Conclusion, large pleural effusion and question of pericardial effusion.

Kidney Plates: Large mass in left flank extending over crest of ilium which is distinctly kidney-shaped. Right kidney not clearly outlined because of gas in colon. Liver edge plainly seen.

Pathological Report (Dr. Wm. A. Perkins). Autopsy performed eight hours after death. The body was that of a normally developed but emaciated boy of ten

years. *Skin*, the superficial veins over the chest and abdomen and particularly those over the lateral aspect of the upper left chest were markedly dilated. Superficial lymph-nodes, not enlarged. *Neck*, the jugular veins were prominently distended. *Chest*, asymmetrical, the left side noticeably larger and fuller than the right with the left interspaces obliterated. Abdomen, greatly distended, with the distention more marked on the left; the abdominal wall was tense preventing accurate palpation. Extremities, wasted. *Genitalia*, the left scrotum contained a small firm ovoidal nodule measuring $1\frac{1}{2} \times 1 \times 1$ cm.; this lay in a position corresponding to the left testis; the skin over it was adherent; the right testis was high in the scrotum and normal in size.

The usual mid-line incision was made; the abdominal wall was stretched and thin. *Peritoneal cavity*, contained a moderate quantity of turbid pale colored fluid (about 300 c.c.) resembling the fluid of a chylous ascites; the peritoneum was smooth; the stomach was greatly distended and occupied the mid-abdomen; no obstruction was found; to the left of the stomach in the left upper quadrant was a large mass projecting downwards from beneath the rib margin, covered by diaphragm and displacing the spleen downward, the stomach to the right, and the liver downward and to the right; retroperitoneally between the kidneys was a second mass moderately large and nodular, from the lower end of which there extended an irregularly thickened cord of tissue which could be traced along the left spermatic vessels, through the left inguinal canal and into the left scrotum; these structures will be described later. *Sternum*, on removing the sternum it was necessary to cut the left half of this structure from an underlying adherent mass; to the posterior aspect of the sternum were attached several tumor nodules of different sizes all consisting of the same type of tissue, also to be described later. *Pleural cavities*, the right pleural cavity contained a small quantity (about 150 c.c.) of pale turbid fluid similar to that found in the peritoneal cavity; adherent to the pleura on this side were large numbers of various sized tumor nodules resembling those found on the sternum; the left pleural cavity was not seen at this time. *Pericardial cavity*, was displaced completely to the right of the midline; this contained about 50 c.c. of clear straw-colored fluid.

In order the more accurately to determine the relations between the tumor masses and the viscera involved, a modified order of procedure was followed; the same order will be observed in the description of the case; the abdominal viscera were removed first: *Liver*, normal in size; on the diaphragmatic aspect of the right lobe were four small slightly elevated nodules of pale yellowish white tissue without umbilication; on section the cut surface of the nodules bulged above the liver surface; it was pale white, homogeneous, moist, slightly translucent, fairly firm, sharply outlined, and surrounded by a narrow hemorrhagic zone of liver tissue; multiple sections of the liver revealed three other similar nodules embedded in the tissue depths; the largest of these was about 1 cm. in diameter. *Gall-bladder*, wall somewhat thickened and opaque. *Spleen*, slightly enlarged, otherwise negative. *Gastro-intestinal tract*, stomach, negative except for distention. *Small intestine*, mucosa markedly hyperæmic; 1 meter from the ileocecal junction was a large bulbous diverticulum 5 cm. long by $2\frac{1}{2}$ cm. wide with a constricted neck 1 cm. in diameter. *Large intestine*, negative. *Appendix*, 10 cm. long, adherent to cæcum. *Pancreas*, negative. *Mesentery*, contained numerous somewhat enlarged lymph nodes; these were grossly free of tumor. *Adrenals*, appeared normal. *Kidneys*, were displaced slightly laterally by the retroperitoneal mass, the left somewhat more than the right; they were normal in size, also on section except that the pelvis of the right kidney appeared slightly dilated; the right ureter pursued a somewhat tortuous course along the outer and lower borders of the retroperitoneal mass and was slightly compressed thereby; attached to the fatty capsule of the right kidney on its deeper mesial aspect but not invading the

kidney substance was a flattened tumor nodule $2\frac{1}{2} \times 2 \times 1$ cm. *Urinary bladder*, negative.

The remaining viscera were removed together, and will be described as a whole, beginning with the *contents of the left chest cavity*. This consisted of a large mass everywhere adherent to the chest wall but readily separable therefrom by finger dissection. The mass was roughly kidney-shaped, corresponding to the shape of the chest cavity with hilum towards the middle mediastinum. It measured $27 \times 16 \times 13$ cm. with a vertical circumference of 80 cm. and a lateral circumference of 53 cm. The external surface was rough and uneven, and apparently composed of greatly thickened parietal pleura. Here and there was seen a suggestion of a small tumor nodule. Inferiorly in the angle between the diaphragm and the general mass was found a definite nodule $3\frac{1}{2} \times 2\frac{1}{2} \times 1$ cm. On incising the large mass along its lateral border a cavity was found containing about 400 c.c. of blood-stained fluid. This was evidently the left pleural cavity, bounded by a dense wall of markedly thickened pleura measuring from 4 to 12 mm. thick. The latter consisted of a homogeneous, firm, pale white tissue from the inner surface of which there projected inward into the pleural cavity clusters and groups of large and small tumor nodules in a most striking array. These nodules measured from 3 mm. to 8 cm. in diameter, the larger ones predominating; in shape they varied somewhat depending upon their grouping; many were compressed laterally by their neighbors, others more isolated tended to be spherical; some were pedunculated; the majority, however, were attached by a broad base; the surfaces of all were smooth, their color generally a pale yellowish-white, sometimes irregularly mottled with reddish-brown, their cut surfaces bulging, homogeneous, pale, yellowish-white, the tissue firm, rubbery, and slightly translucent, slippery and smooth but not sticky, in some instances marked by fine purplish or reddish striae probably blood-vessels. The largest nodules were situated mesially and on section, showed enclosed the compressed remnants of the left lung. The latter appeared as two relatively narrow condensed strata of somewhat sunken dark red airless tissue separated from one another by a broad zone of coalescent tumor nodules. The lung, containing mass measured $13 \times 7 \times 5$ cm. and of this the lung tissue proper composed about one-fourth the bulk. The pulmonary arteries and bronchioles while intimately related to the invading tumor nodules were not actually invaded by them. The *right lung* was small, $15 \times 10 \times 5$ cm.; the pleural surface was covered by multiple small tumor nodules appearing as rounded elevations from 2 mm. to 2 cm. in diameter. Except for size these resembled the nodules described in the left chest cavity. Adherent to the mesial border of the lower lobe of the right lung was a pedunculated nodule $4 \times 3 \times 2\frac{1}{2}$ cm. On section the right lung was red and oedematous, but without evidence of consolidation of emphysema. Embedded in the lung were a few small tumor nodules, the largest 2 cm. in diameter situated in the lower lobe. Some bronchioles and arterioles lay in the immediate vicinity of this nodule but did not pass through it. The *pericardial cavity* was compressed laterally by the large mass in the left chest. The pericardium itself appeared free of tumor invasion. The *heart* was slightly smaller than normal; otherwise it was negative. The *large vessels* entering and leaving the heart were in their normal relative positions. The left innominate vein as well as the large branches of the aortic arch were imbedded in and compressed by the upper end of the large mass in the left chest; there was, however, no actual tumor invasion. The *aorta* pursued a normal course through the chest and abdomen. Surrounding it in its abdominal portion was a *conglomerate mass of tumor nodules* $11 \times 5 \times 5$ cm. These resembled the nodules found in the chest. They formed the retroperitoneal tumor mentioned above that lay below the diaphragm and between the kidneys. There was no apparent direct connection between this mass and the nodules in the chest. The aorta was not involved

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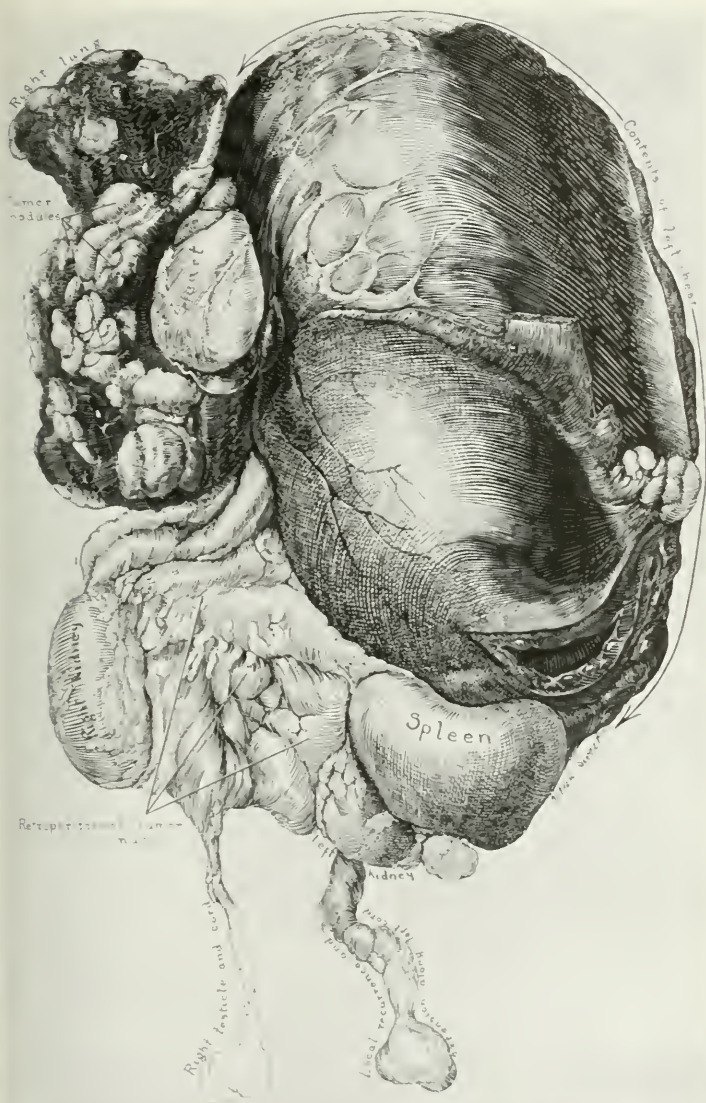


FIG. 1.—General view showing recurrent nodule in left scrotum, with extension along left cord and left spermatic vessels to retroperitoneum, and the ax.

in the growth. The *inferior vena cava* was irregularly compressed by the retroperitoneal mass and on opening the vessel, a small smooth tongue-like bit of tissue was found projecting into the lumen through an aperture lying 2 cm. below the entrance of the renal veins. On section this small projection appeared directly



FIG. 4.—Left pleural cavity opened showing tumor nodules.

continuous with an adjacent extravascular tumor nodule. United to the lower end of the retroperitoneal mass on its left side was an *irregularly thickened cord* which followed the course of the left spermatic vessels downward through the inguinal canal and into the left scrotum to end in the nodule mentioned earlier in the description. Multiple sections through the cord showed these nodular thickenings to consist of tumor tissue similar to that found in the chest; they lay apparently outside the spermatic vessels. The *nodule in the left scrotum* was also composed of tumor

tissue similar to the above; no normal testicular or epididymal tissue was found on this side. The testis and epididymis on the right lay high in the scrotum but were otherwise negative.

Microscopic Report.—Sections from the *nodule in the left scrotum* show a richly cellular tissue composed of numerous undifferentiated polyhedral cells supported by a connective tissue stroma. The cells vary in their arrangement, occurring in some places diffusely or in sheets, in other places and quite frequently as more or less continuous linings of numerous small irregular spaces. The latter are formed by an anastomosing net-work of connective tissue strands and give to the growth an alveolar-like structure. The cells lining these spaces as well as those diffusely present are in general poorly defined, possessed of very little cytoplasm, and, for the most part, made up almost entirely of large vesicular nuclei. The latter contain a varying amount of chromatin, usually finely granular and fairly evenly distributed. Some of the nuclei are relatively hyperchromatic. A certain proportion possess nucleoli, though this is not a prominent feature. Mitotic figures are numerous. The stroma of the growth consists of finer and coarser strands of a pale fibrillar tissue that take the blue stain by Mallory's aniline blue method. These are present throughout the nodule, sometimes and most frequently as an exceedingly delicate reticulum, at other times appearing as a broad, smooth, branching hyalin net-work approaching a fibro cartilaginous appearance but showing no tendency to basic staining. Stroma and parenchyma are present in about equal amounts though varying somewhat in proportion in different areas. Scattered here and there throughout the stroma are a few small rather darkly staining cells, consisting of lymphocytes, neutrophiles, and degenerating tumor cells. These are far too few in number to be regarded as forming a "lymphoid stroma" so frequently described by Chevasse as occurring in "seminomes."

The tissue in general is supplied by a moderate number of small thin-walled blood-vessels. A search through several sections shows no structures or tissues other than those described. Sections through the region of the *left spermatic cord* show an encapsulated nodule composed again of undifferentiated cells in a connective tissue stroma. The cells are diffusely arranged, often widely separated as if by oedema and marked by a slight tendency to assume a spindle shape. Some of the nuclei are large, palely staining and with their chromatic material separated as if by excessive fluid; other nuclei show an irregular lobulation. Scattered here and there are small numbers of lymphocytes. In the centre of the nodule is a mass of the tumor cells completely filling a thin-walled vessel, probably a lymphatic. The *vas deferens* and accompanying blood-vessels lie outside of the nodule and do not appear to be involved. Sections through the nodular *retroperitoneal mass* show lymph-nodes in which the lymphoid stroma has been almost completely replaced by undifferentiated tumor cells. These line and fill the sinuses crowding peripherally any of the lymphoid tissue that may remain. Some of the cells here as above show a tendency to become spindle-shaped. Associated with the tumor invasion is a diffuse but scanty increase in the connective tissue stroma. Sections through the left parietal pleura show this to be tremendously thickened by invading tumor. Along the outside of the section (nearest the ribs) is a narrow strip of oedematous connective tissue representing the remains of the original connective tissue stroma of the pleura; inside this is an irregular zone of small injected blood-vessels, while within this again is the area of tumor invasion. These three zones, while roughly distinct, are yet continuous with one another.

The third or tumor zone forms an exceedingly thick coat and is composed of cells that are largely spindle-shaped. Mitotic figures are numerous. From this section alone it might be difficult to distinguish the growth from a spindle-cell

sarcoma. Sections through the *left lung* show first the visceral pleura thickened like the parietal pleura: nearest the lung is a fairly definite strip of fibrous tissue, the original fibrous tissue of the pleura and beyond this a thick layer of poorly staining tumor cells lying in a connective tissue stroma. Throughout the latter and particularly in its superficial portions are large extravasations of red blood cells. Second, from the pleura the tumor is seen to be invading the lung itself. Here the growth appears as rounded, fairly well circumscribed masses of undifferentiated polyhedral and spindle cells lying in a definite fibrous stroma. In certain places where three or more of these masses lie adjoining one another, angular-shaped remnants of lung parenchyma remain; the latter consist of squeezed and distorted alveoli, lined in part by flat atrophic epithelium, in part by large and swollen cells, often desquamated, frequently eosinophilic and occasionally fused to form large multinucleated giant cells. At the edges of these lung remnants the tumor growth can be seen to extend within the alveolar walls, with first a thickening of the latter, then a compression and distortion and finally a collapse of the included alveolar spaces. Sections from the *right lung* show a similar picture but on a much smaller scale. Here the tumor masses extend inward from the pleura as small wedges along the connective tissue septa. In advance of some of them collections of tumor cells may be seen lying free in thin-walled non-blood containing spaces, probably lymphatics, while similar spaces similarly filled are not infrequently noted within the wedge-shaped masses themselves.

Sections from the *diaphragm* show on the pleural surface massive polypoid growths composed of cells similar to those described. These are associated as above with a diffuse connective tissue stroma. One section shows the formation of small irregular spaces lined by tumor cells very much resembling the picture seen in the scrotal nodule. There is no invasion of the diaphragmatic muscle itself. Sections through the *nodules in the liver* show these to consist of polyhedral tumor cells arranged on a net-work of connective tissue strands, giving again an alveolar almost carcinomatous appearance to the growth. No spindle-shaped cells are seen. The borders of the nodules are sharply separable from the adjacent compressed liver tissue. Sections through the *small tongue of tissue* described as protruding into the venacava inferior show this to consist of tumor tissue lying in a medium sized blood-vessel and continuous with other tumor masses filling the vessel. Surrounding the vessel are multiple tumor nodules, apparently retroperitoneal lymph-nodes completely or almost completely destroyed by tumor invasion.

Briefly then we have to do with a malignant tumor originating apparently in the left testis, recurring there after removal, extending along the left spermatic cord to the retroperitoneal lymph-nodes, and thence by way of the lymphatics and blood stream to the pleura, lung, diaphragm, and liver. The cells composing the growth are in general embryonic in type, yet they are not without some differentiation as may be evidenced by the tendency to alveolar formation noted in the scrotum, liver and diaphragm, and by the striking resemblance to spindle-cell sarcoma seen in the left pleura and to a less extent in the lungs and lymph-nodes. Furthermore the smooth, almost cartilaginous appearance of certain areas of the stroma in the scrotal nodule suggests other differentiation. In the matter of classification we are handicapped since we were unable to secure the original tumor for examination. It is possible that the latter contained other types of tissue such as cartilage, bone, etc., or even rudiments of organs, thus putting the tumor in the group

of either embryoid or adult teratomata. In this case we would have to assume that one of the tissue composing the tumor had undergone a malignant change and outgrown all the rest. This occurrence is rare in adult teratomata, but apparently not uncommon in the embryoid type. Lacking such confirmatory evidence, however, and based on the material at hand, it would seem that the group called by Ewing embryonal carcinomata would be best

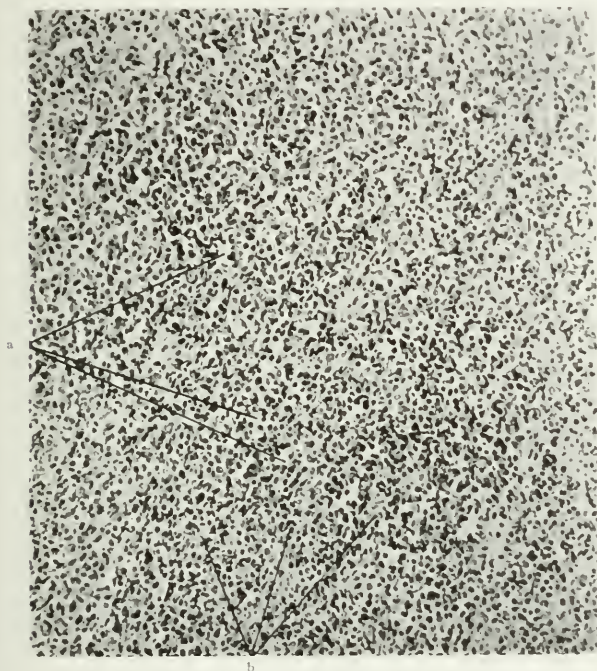


FIG. 5.—Nodule in left scrotum showing both the alveolar (a) and the diffuse (b) arrangement of tumor cells.

adapted to our case. And yet it does not compare accurately with anyone of the examples therein described. The lymphoid stroma so commonly found in that type of tumor is lacking and again the extent and size of the metastases in our case render it most unusual. Finally we cannot place the case in the group of tumors described by Chevassu as "seminomes" and included by Ewing in his class of embryonal carcinomata since in these the cells are pictured as relatively large, composed of a clear cytoplasm, possessed of nuclei rather poor in nuclear material, but provided with one or more nucleoli,

the whole supported by a stroma very small in amount and frequently marked by collections of lymphocytes, none of which features are present in our case. As much by the process of elimination, therefore, as by any other procedure, we are constrained to classify our case as an embryonal carcinoma.

Historical Note and Discussion.—As early as 1696, St. Donat described a complex tumor of the testicle in which he recognized the bones of a rudi-



FIG. 6.—Nodule in left scrotum showing the cartilaginous-like stroma (a) also the alveolar arrangement of tumor cells (b).

mentary skull and two pigmented depressions which he interpreted as the embryonic eyes of a parasitic foetus (Ewing). In 1845, Sir Astley Cooper wrote an elaborate treatise on the gross anatomy of teratoma testis. Johnson in 1856 was the first to recognize the tridermal constitution of such tumors. Langhans, who was apparently the first to use the microtome in his microscopic work, together with Kocher, in 1887, laid the basis for an accurate classification of testicular tumors according to microscopic structure. They were the first to suspect that the group of teratomata embraced a large proportion of all tumors of the testicle. Wilms, in 1896, was the first to

demonstrate the fact that most tumors of the testis were teratoid in nature. In 1911, Ewing presented an excellent review of the literature and a pathological study of a series of cases and came to the conclusion that practically all tumors of the testicle were of teratomatous origin.

He thus challenged the contention of Chevassu, whose exhaustive treatise was published in 1906, and that of Debernardi appearing the same year. Chevassu demonstrated that a large proportion of tumors of the testicle were of the solid medullary, large cell type, the cells being identical in morphology and staining reactions with those of the spermatogenic cycle. He therefore

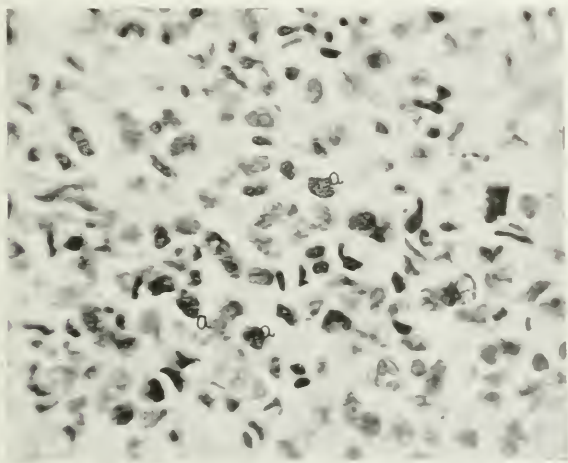


FIG. 7.—High power of Fig. 6, showing the tumor cells with scanty cytoplasm and large nuclei, some hyperchromatic, showing also the absence of lymphoid stroma.

derived a large proportion of testicular tumors from the spermatoblasts and called them "seminomes." Tizzoni (1876), Birch-Hirschfeld (1877), Talavera (1879), and Langhans (1887), traced in detail the gradual transition from the spermatic tubule cells, or spermatoblasts, to the so-called "seminome." Chevassu, although a champion of the spermatogenic origin of this type of growth, regarded this earlier work as unreliable, since he himself had been unable actually to demonstrate this transition.

Thus, although the classification of testicular tumors has become greatly simplified, there have arisen two opposing schools, one maintaining that "for practical purposes there exists only one tumor of the testicle, namely, a teratoma." (O'Crowley and Martland, Ewing, Wilms, Pick, Ribbert, etc.,) the other maintaining that a large proportion of testicular tumors are pure tumors (seminomes) derived from the cells of the spermatic tubules

(Chevassu, Frank, Schultz and Eisendrath, Sakaguchi, Vecchi, Birch-Hirschfeld, Tizzoni, Langhans, Talavera, Geist and Thalheimer, Hardouin and Patel, etc.).

There is probably no field in pathology where more divergent views have been and still are current. A survey of the literature shows that oncological terminology has been just about exhausted in supplying diagnoses for cases

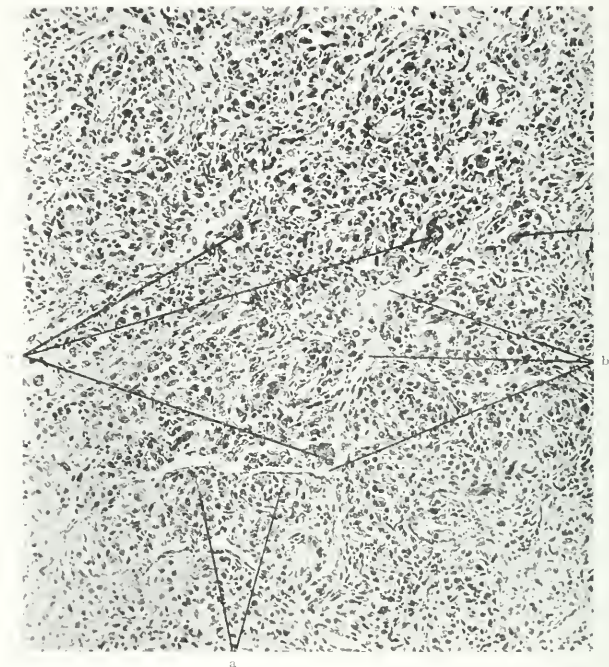


FIG. 8.—Left lung showing the tumor invasion, extension within alveolar walls (a) distortion and collapse of alveolar spaces (b) eosinophilic epithelial cells (c) "Giant Cells".

reported in spite of such contributions as that of Ewing. We cannot therefore emphasize too strongly the importance of a more general knowledge of the pathology of testicular tumors. This would seem to indicate that there exists two large groups, the teratomata (heterologous tumors) and the "seminomes" (homologous tumors), while tumors of other types are extremely rare. The following classification, which is borrowed from the noteworthy article by Schultz and Eisendrath (1921), is proposed as the most logical and complete in our present knowledge of the subject:

MALIGNANT TUMORS OF THE TESTICLE IN CHILDREN

I. *Homologous Tumors:*

A. *Benign:*

1. *Epithelial:*

- (a) Adenoma of the seminal tubules [the tumors of Chevassu and of Pick (Ewing)].

2. *Mesoblastic:*

- (a) Fibroma, arising in the tunica (the tumors of Lardennois and Lecene, Makins and Boyer).
- (b) Leiomyoma, arising in the epididymis (Ewing accepts the tumors of Trelat, Rindfleisch, and Hericourt; Schultz and Eisendrath report a similar case).
- (c) Vascular tumors (lymphangioma, hemangioma).
- (d) Interstitial cell tumors (Ewing considers a specimen in his own laboratory and the case reported by Chevassu, as examples of hyperplasia rather than neoplasia).

B. *Malignant:*

1. *Epithelial:*

- (a) *Spermatocytoma* (seminome of Chevassu).

2. *Mesoblastic:*

- (a) Sarcoma (extremely rare; possibly Sakaguchi's case and three of Miyata's cases arising in the tunics may be accepted).

II. *Heterologous Tumors:*

A. *Benign:*

1. *Cystic dermoid:*

B. *Malignant:*

- 1. *Embryonal carcinoma.* Heterologous tissue may be present or may have been overgrown. The atypical tissue may be:
 - (a) Trophoblastic (chorio-epithelioma).
 - (b) Hypoblastic (the usual adenomatous tumor).
 - (c) Epiblastic (solid alveoli of basal cell type or tumors of neurocytoma type).
- 2. *Sarcomatous mixed tumor* (true sarcoma in a teratoma seems to be rare).

Careful study has shown that tumors other than the spermatocytomata (homologous tumors) and the embryonal carcinomata (heterologous tumors) are of such extreme rarity as to be practically disregarded. If we accept Ewing's dictum that the spermatocytomata as such, does not exist but are forms of embryonal carcinomata, we may say that homologous tumors of the testis are so rare as to be scarcely worthy of mention, and that practically speaking there is but one type of tumor of the testis, namely teratomata (embryonal carcinomata). The vast majority of cases reported in the literature have been diagnosed some type of sarcoma, but as Ewing and Schultz and Eisendrath point out, the vast majority of malignant tumors of the testis are of epithelial and rarely, if ever, of mesoblastic origin. We must, therefore, for all practical purposes, discard the term sarcoma testis as a misnomer. An apparent exception is Ewing's case of primary lymphosarcoma of the testis in a boy aged five and one-half years. "Seminomes" and teratomata occur with about equal frequency in the literature. Chevassu reports 59 "seminomes" and 61 teratomata. It still remains to be determined

definitely whether the so-called "seminomes" are derivatives of the epithelium of the seminiferous tubules, as Chevassu first maintained, or are to be classed as teratomata, as Ewing maintains. In a future publication from the Departments of Urology and Surgical Pathology, a careful pathological study of a series of cases will be reported with a view to adding to the evidence gradually accumulating in this discussion.

Occurrence in Children.—Five of Chevassu's 61 cases of teratomata

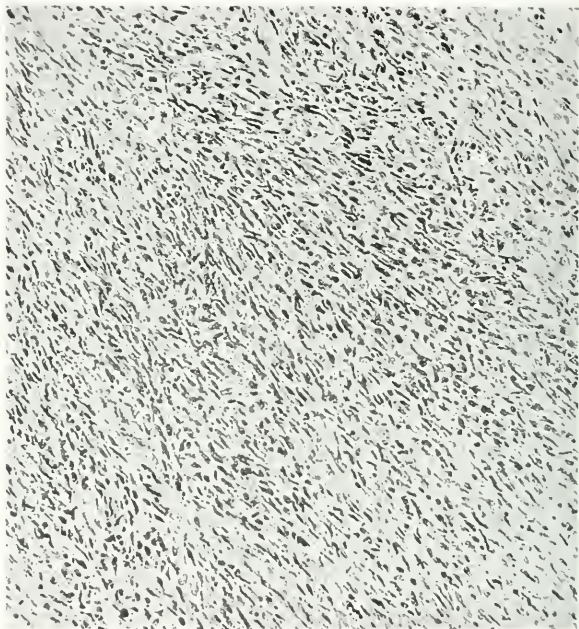


FIG. 9.—Left parietal pleura showing the spindle-shaped tumor cells.

occurred in children and none of his 59 "seminomes." Kober (1899) reviewing the English and German literature collected 107 cases of "sarcoma of the testicle." In 97 of these the age was stated and only 10 occurred in children under ten years. (His article included one case reported in this country by Deaver.) The comparatively few cases of tumor of the testis in children found after a fairly exhaustive search of the literature attest their relative infrequency as compared with their occurrence in adults. A few dermoids have been reported in children (Kelley). Ewing regards these as teratomatous in nature. Steffen and Gerhardt state that in children tumors

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of the testis occur chiefly in earliest infancy, generally within the first six months or year, gradually diminishing in the second, third, and fourth years, and seldom occurring in later childhood. Kober found no cases between the ages of ten and fifteen years. Steffen concludes that the majority of these tumors are congenital. They are often noticed by the mothers at birth. In many cases there was a previous trauma. In the majority this was apparently simply a stimulus to the further development of a latent tumor.

Testicular neoplasms are relatively more frequent in undescended testes than in normally situated organs. This frequency, however, is not so great as is shown by the following table:

Relative Frequency in Undescended Testicles.

	Author	Hospital	Number of cases of undescended testicle	Number of testicular tumors	Percentage		
A. Among undescended testicles in general	Eccles	Hospital for Ruptured and Crippled Children	859	0	0.17		
	Coley						
	Kocher	Eiselberg's Clinic	1357	0			
	Brenner		1000	1			
	Hoffstätter		75	0			
	Goeritz	181	4				
	57	1					
			3539	6			
			Testicular tumors	In undescended testicle			
				Ing.	Abd.	Total	
B. Among testicular tumors in general	Howard	General	57			9	15.7
	Chevassu		128	10	5	15	11.7
	Odiorne & Simmons	Johns Hopkins	54	2	4	6	11.1
	Coley		64			12	18.7
	Kober		114			18	15.8
	Hinman		32			7	21.7
	Von Kalhden*		41			5	12.1
	Ufferduzzi		159			6	3.7

* Cited by Lipschutz, *ANNALS OF SURGERY*, August, 1922.

In Howard's report of 110,000 patients, 57 cases of malignancy occurred. Of these 9 occurred in undescended testicles, a ratio of 1:6 $\frac{1}{3}$ (15.7 per cent.). This ratio is out of all proportion to that between abnormally and normally placed testicles which according to Rennes is 1:600 (0.16 per cent.) and according to Marshall is 1:1000 (0.10 per cent.) (quoted by Chevassu). In Chevassu's 128 cases of tumors of the testicle, 15 occurred in undescended testicles giving a ratio of 1:9 (11.8 per cent.). Odiorne and Simmons in 54 cases of malignancy found 6 in undescended testicles, a ratio of 1:9 (11 per cent.). In 64 cases of "sarcoma" observed by Coley, 12 occurred in

undescended testicles, a ratio of 1:5½ (18.7 per cent.). He also shows the frequency with which undescended testicles complicate hernias. In 80,736 cases of inguinal hernia occurring in male adults 1357, or 1:59½ (1.68 per cent.) were associated with undescended testicles. In 59,235 cases of inguinal hernia in the male sex at the Hospital for Ruptured and Crippled Children (1890-1907), there were 737 cases of "sarcoma" of the undescended testis. The frequency of malignancy in the intraabdominal testicle



FIG. 10.—Tumor nodule in liver showing alveolar arrangement of tumor cells (a); also absence of lymphoid stroma. Picture resembles that of scrotal nodule.

is slight, the proportion here being 1:60,000 (0.0017 per cent.) of male admissions to general hospitals. One out of every 75 intraabdominal testes will become malignant and 25 per cent. of malignant undescended testes are intraabdominal (Bulkley).

Trélat states that the left testis is involved more often than the right and that very seldom both may be involved. In our review of the literature we are unable to substantiate this statement. In Chevassu's series the right was involved 56 times and the left 50. Cunningham reports a series in which the right was involved 34 times and the left 25. From these statistics and others, it appears that the frequency on the two sides is about equal. The occurrence of bilateral tumors is very rare, Chevassu, noting only one in

128 cases. Kober noted five in a series of 93, while Cunningham found three in 67.

The tumors generally resemble a hen's egg in size and shape. They are sometimes differentiated from hydrocele or hæmatocele, tuberculosis or gunnma with difficulty. Their consistency varies, some are hard and nodular, others are smooth, and still others are cystic and fluctuant. According to Steffen the rate of growth varies, the hard tumors growing slowly, the soft type rapidly. They may attain the size of a man's fist or larger. The overlying skin is rarely invaded, though it sometimes becomes discolored and shows varicose veins. If the skin breaks through fatal hemorrhage may occur. The tumors generally develop without pain or symptoms of any sort. Attention may first be brought to them by their size or weight. If the tunica albuginea and outer coverings are involved, pain is present. Cachexia then appears and death follows soon after unless the termination is brought on sooner by generalized metastases. In none of the cases in children which we have been able to find in the literature have such large and extensive metastases been described as were present in our case. Lee described a case of tumor in the right testicle of a boy, age six years, which was "adenocarcinoma" with metastases in the epididymis, both lungs, lymphatics of posterior abdominal wall, left parietal lobe of the brain and right kidney; he asserted that both the blood and lymph circulation must have been involved. A similar process occurred in our case where a tongue-like piece of tumor tissue was found projecting into the inferior vena cava. Another extensive and unusual case is the one of double teratoma reported by Lovett and Councilmann, in which the testis and head were involved independently of each other.

The type of tumor of the testicle most usually found in infancy and early childhood is the teratoma. We have found but one case of "seminome" at this age; this occurred in a boy of seven years (Hardouin and Patel). All of Chevassu's 5 cases in children were teratomata. Philipp in reviewing the literature found 42 cases of tumor of the testis in children, conspicuous among which was the great number of simple embryomata (teratomata). From the above it is apparent that teratomatas are most frequent in early infancy while "seminomes" are more usually found in later life. A glance at the following graphic illustrates this quite well. (Fig. 11.)

The prognosis of malignant tumors of the testicle is bad in both children and adults. In Kober's series of 10 cases in children, 4 died of metastases within 1 year of operation (castration); 1 was living 2 months post-operative, but with metastases in the right lower quadrant, while in the remaining 5, no end results were given. If we exclude the last 5 cases, the mortality in this series would be 100 per cent. In Steffen's series which consisted of 25 cases, including his own and others collected from the literature, 13 were dead from recurrence or metastases within 11 months after operation; 7 were living and of these 3 had had recurrences, 2 were living and well 11 months post-operative and 2 were living with their condition not stated. Two cases were

mentioned with insufficient data. No end results were given in the other 3 cases. If we eliminate the last 5 cases, there are 16 cases either living or dead with metastases and recurrences out of 20 cases. This gives a mortality of 80 per cent. There are various single case reports most of which terminated fatally in spite of operation. (Scheel, Schubert, Stenger, O'Crowley and Martland). From Chevassu's series the outlook, however, is brighter. He had 5 cases of teratomata in children out of a series of 128

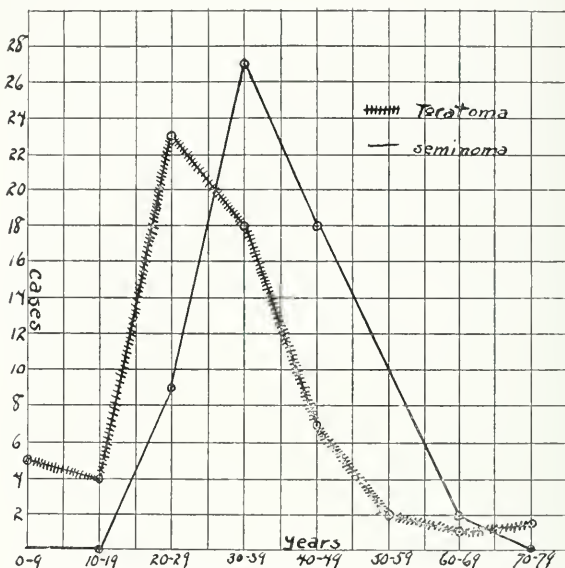


FIG. 11.—Chart (from Chevassu) showing age incidence of seminoma and teratoma. Note that there are five teratomas under the age of five years; no seminomas under the age of twenty years, and only one under twenty-seven years.

teratomata and "seminomes." Four of these cases were living and well 5 months, 2 years 6 months, 2 years 7 months, and 3 years 8 months after operation, respectively. The course of the fifth case was not known. The first case was an embryonic teratoma which is a very malignant type. The other three cases were adult teratomas which are quite similar to dermoids. According to Ewing, this type of teratoma is far less malignant than the embryonic, hence it is not so surprising that the results in Chevassu's cases were so good. We find that Kelley has reported one such case (dermoid) living and well seven and one-half years after operation. Moran cites a case of teratoma in an 8 months' old infant that was living and well 5 years after castration. In summing up Chevassu's entire series (adults and children),

we find that the teratomatas are more malignant and run a more rapid course than the "seminomes"; that 6 out of 47 (13.8 per cent.) are living and without recurrence over two and one-half years after castration; that in the case of "seminomes," 13 out of 49 (26½ per cent.) are living and without recurrence more than one year after operation. Taking the series as a whole, 81 per cent. died and 19 per cent. lived following simple castration. There are a few cures of malignant tumor of the testis in children on record. Morrison's case was living and well 11 years after operation. Berger reported a case living and well 2 years after castration. Coley had a remarkable case in which there were local recurrences after 2 operations both performed within 5 months. A third operation was performed and a series of injections of mixed toxins of erysipelas and *B. prodigiosus* were given; the patient was living and well more than one year later.

From the above it is at once apparent that simple castration is inadequate. Our case illustrates that point very well. The results of the radical operation as advocated in France by Gregoire, Chevassu, etc., and in this country by Hinman, offer some hope of improvement in the treatment of these cases in the future.

SUMMARY

1. Malignant tumors of the testicle in children are comparatively rare.
2. These tumors are extremely malignant and of them, the teratoma which is found mostly in early childhood, is the most malignant.
3. The prognosis of malignant tumors of the testicle in children is very grave.
4. The mortality rate is very high and has as yet been very little influenced by present methods of treatment.
5. The case reported is probably an embryonal carcinoma of the left testicle; that this tumor is highly malignant is evidenced by the local recurrence, the extensive metastases to the lungs, right lobe of the liver and retro-peritoneal lymph-nodes and by the invasion of the inferior vena cava.

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ACUTE DEFERENTITIS AND FUNICULITIS

BY ABRAHAM O. WILENSKY, M.D.

AND

SAUL S. SAMUELS, M.D.

OF NEW YORK, N.Y.

FROM THE SURGICAL SERVICE OF MOUNT SINAI HOSPITAL, NEW YORK

THE earliest note on deferentitis and funiculitis appears in an old volume by Benjamin Bell, "A Treatise on Gonorrhoea Virulenta and Lues Venerea," published in 1795. Bell's description of "swellings of the spermatic cord arising as a complication of acute urethritis" is still worthy of repetition:

"It sometimes happens that inflammation of the testicle spreads to the cord, and excites pain and tumefaction along the course of it. At other times the cord inflames without any previous affection of the testis; it becomes tense, hard and painful. The swelling, for the most part, is, at first, confined to the vas deferens, but, at last, the other parts of the cord suffer also."

Bell also met with some cases "in which one or two tumefied parts were perceived in the course of the cord, while the rest of it remained sound; but, in general, the cord is equally affected, from the testis along its whole course up the groin."

Before going on to a further consideration of the subject, it may be well to review the anatomy of the structures involved. This will also aid in establishing a more logical nomenclature, since in the literature on the subject the terms "deferentitis" and "funiculitis" are sometimes used interchangeably, with resultant confusion. The differentiation will become apparent in the latter part of this communication.

It must be borne in mind that while the spermatic cord extends only from the internal abdominal ring through the inguinal canal to the testicle, the vas deferens—its main constituent—is continued through the internal abdominal ring along the lateral pelvic wall to the base of the prostate.

The spermatic cord—*funiculus spermaticus*—is composed of the following structures: the vas deferens accompanied by the deferential artery and veins; the spermatic artery; the pampiniform plexus of veins; the spermatic plexus; the deferential plexus of the sympathetic nerve; and the ligament of Cloquet, which is a cord-like remnant of the funicular process of the peritoneum. All of these are supported by a connective-tissue framework. The three fascial coverings of the cord are not, strictly speaking, parts of the cord proper. The spermatic cord also carries the lymphatics of the testicle, of the epididymis and of the visceral layer of the tunica vaginalis testis. The lymphatic channels follow the course of the spermatic blood-vessels and drain into the lateral and anterior aortic nodes.

The vas deferens contains three coats: (1) An internal mucous coat; (2) an intervening muscular coat; and (3) an external areolar coat. At no part of the course of the vas deferens is the latter in intimate contact

with the peritoneum except in the general neighborhood of the internal abdominal ring as it passes outwards and onwards in the inguinal canal. The presence of a hernial sac exaggerates this relationship. In the depths of the pelvis an appreciable interval separates the vas deferens and the peritoneum. The latter anatomical facts are important in the cases of deferentitis pelvica to be described later, and in the uncommon cases of peritonitis arising from this source.

Various types of acute deferentitis and funiculitis are reported in the literature. After careful consideration it seems best to divide all acute inflammatory disease of the spermatic cord into the following three main groups:

- A. Acute gonococcus deferentitis and funiculitis.
- B. Acute streptococcus funiculitis—"endemic funiculitis."
- C. Acute funiculitis of indeterminate origin.

Acute Gonococcus Deferentitis and Funiculitis.—This complication of acute urethritis usually occurs about four weeks after the initial infection. When an acute epididymitis is also present, the symptoms and physical signs of the latter condition dominate the clinical picture. This is the ordinary form of this complication and the involvement of the vas deferens in the pathological process is either not recognized as an entity, or, possibly, even ignored by the average observer. Deferentitis and funiculitis, however, can occur without a coincident involvement of the epididymis or testis and our observations and remarks in this communication have reference to this form only.

Following the observation of Bell, quoted above, a long time passed before other cases were described. In 1868, in the *Gazette des Hopitaux*, there is a report by Gosselin of a case of funiculitis without epididymitis. The onset of the disease occurred five months after an attack of acute urethritis and the swelling and tenderness of the cord was limited to the confines of the inguinal canal. Similar cases were described by Kohn in 1870.

An interesting form of this type of deferentitis was described by Neumann in 1884, and later by Nobl in 1906. Here the inflammatory process was confined to the intrapelvic portion of the vas deferens. There were either no subjective symptoms, or merely pain on defecation. Rectal examination in these cases revealed a thickened, tender ampulla, from which the thickened vas tapered up to its point of exit through the internal abdominal ring. Externally, the vas and cord were apparently not involved. Several cases are remembered in our own hospital experience in which this condition probably existed but was not recognized. The patient was admitted with what was at first thought to be an acute appendicitis; the classical symptoms of this condition were present, including a certain amount of spasm of the rectus muscle. Physical examination showed, however, that a well-marked acute urethritis was present and in each of the few experiences of this kind, the urethral condition was the determining factor in deciding against operation. It was believed that the pathological process included an acute adenitis within the pelvis. The absence of any change in the testis and cord in the groin

led us to believe that there was no change in the pelvic portion of the vas deferens. In view of the information now available, it is fair to question the correctness of this diagnosis; probably a deferentitis pelvica was present.

In all of these cases there is most likely a focus of infection in the posterior urethra or prostate. From the latter point the gonococci can be transported to the epididymis (1) either by the lymphatics, or (2) by retrograde peristalsis of the vas deferens as described by Loeb and others. If, in their journey, the organisms penetrate the coats of the vas, a deferentitis is produced with the following typical microscopical picture: The epithelial cells of the vas become swollen and partially desquamated. There is round-cell infiltration of the submucosa and muscularis. In addition, there is an acute lymphangitis of the vas deferens, as shown by the polymorphonuclear infiltration of the lymph spaces of the muscularis. Should the infection penetrate deeper, a funiculitis is produced.

The entire process usually subsides without operative interference. However, some may go on to the formation of abscesses in the cord. Wossidlo mentions cases of funiculitis of gonococcus origin that were followed by the formation of intra-abdominal abscesses; possibly, some of the obscure and unexplained intra-abdominal abscesses that are observed from time to time on any surgical service could be explained on this basis. Gonococcus peritonitis has been noted by Zeisel.

Endemic Funiculitis.—A suppurative condition of the spermatic cord prevalent in tropical and subtropical countries was first described by Castellani in 1904 in the *Ceylon Medical Reports*. Because of its rather frequent occurrence in that region the disease was termed "endemic funiculitis."

The onset of the illness was unusually sudden. The clinical picture included: (1) a painful and tender swelling of the cord; (2) fever, which was usually high; and (3) vomiting. In some cases the epididymis (4) was also involved, but in all cases the testis proper appeared normal. Gonorrhoea, trauma, filariasis and malaria, which might possibly be thought to be the cause, were excluded in every case. There were a few mild cases which recovered spontaneously. In the majority, the disease terminated fatally with (5) bacteremia, (6) jaundice, and (7) cutaneous hemorrhages unless operative interference was employed.

Anatomically it was established that the spermatic cord, including the vas deferens, became inflamed, infiltrated, and swollen to a circumference of three or four inches. On section pus exuded from the veins of the pampiniform plexus and from the vas deferens.

In ninety-eight per cent. of the cases, Castellani isolated a diplostreptococcus from the pus, and in a few cases from the heart's blood at autopsy. Occasionally the same organism was isolated from the blood during life; this was usually an ante-mortem phenomenon. The organism was Gram-negative in smears of the pus and in smears from the tissues, but became Gram-positive when cultured. Castellani does not state whether the organism hemolyzes blood. This strain of the streptococcus is not agglutinated

by the serum of patients suffering from the ordinary hæmolytic streptococcus infections. In some of the cases the organism was recovered from the urethra.

In the treatment of the endemic type of funiculitis, Castellani recommended complete removal of the cord as high up as possible.

Five years after the appearance of Castellani's paper, in 1909, five cases of funiculitis were reported from Egypt by Coutts. In this series, the disease was confined to young adults; three of them were suffering from a chronic gonococcus urethritis. Clinically, the cases were very similar to those described by Castellani. From four of the cases a diplococcus, similar to the one described by Castellani, was isolated from the tissues in pure culture. Coutts could not distinguish whether the organism was a secondary invader in chronic urethritis or the primary cause of the deferentitis.

The pathology of the lesion in Coutts' cases as exposed at operation, varied from a simple thrombosis of the pampiniform plexus to actual suppuration in the cord and surrounding structures and with definite abscess formation. In all of Coutts' cases the epididymis and testis were not involved. The treatment practised by Coutts was more conservative than that of Castellani; multiple incisions into the swollen tissues with evacuation and drainage of abscess cavities were the only procedures carried out. All of the patients in this series recovered uneventfully.

In 1907, Madden reported two cases of "Cellulitis of the Spermatic Cord" occurring in natives of India. Clinically and pathologically they resembled Castellani's and Coutts' cases in every detail except for the presence of an inflamed hernial sac attached to the cord. In each case the cord was enormously thickened; the veins of the cord were filled with purulent thrombi and there were numerous small abscesses scattered throughout the cord structures. In each case the affected cord was completely excised and an uneventful recovery ensued. Although this paper appeared after that of Castellani, no mention is made of any bacteriological studies.

Jones' case, reported in 1909, from Egypt, is similar to those described by Madden in that a hernial sac was present. Here, again, more definite bacteriological studies might have helped in the classification of the case. At operation the cord was found to be acutely inflamed and markedly thickened; the contents of the hernial sac were irreducible. A further complication was noted: The vermiform appendix, acutely inflamed, was found embedded in the cord structures. While Jones was well aware of the possibility of a primary acute appendicitis with secondary cord involvement as the sequence of events in this case, yet, from his clinical observation, he insisted upon the reverse sequence as the correct explanation.

The series of cases, reported in 1891 by Brown from India, are similar to the series of cases reported above and differ only in that the pathological process had produced more extensive changes; *i.e.*, there was a tendency towards larger abscess formation.*

* We exclude from this discussion the series of thirty-six cases of funiculitis reported by Menocal from Cuba, in which the filarial organism was proven to be the etiological factor.

Comment.—All of the available evidence points to the fact that this type of lesion is, essentially, a thrombo-phlebitis of the pampiniform plexus of the cord. The lesion is most extraordinary. There is a complete lack of evidence which could point to the presence of any focus in the body which might act as a primary lesion and to which the thrombo-phlebitis might be secondary; and Madden's belief that this etiology is present has not in any way been substantiated. Apparently this is a disease peculiar to tropical countries. One does not have sufficient information of the biological phenomena of the streptococcus isolated in the reported cases to enable one to classify the organism properly. Whether the latter is the organism which is so prevalent in our own and other countries, or whether it is a strain to be found only in certain of the tropical countries still remains to be proven. It is still quite possible that the disease is due to some parasite, which, as yet, goes undiscovered; then the streptococcus might play the rôle of a secondary invader, or, even, of a contaminant.

Acute Funiculitis of Indeterminate Origin.—The essential characteristics of the cases in this group are best illustrated by the following case reports:

Hospital No. 229068. The patient, an unmarried man of forty six years, was admitted to the hospital on April 12, 1923, complaining of a painful swelling in the left groin of ten days' duration. Thirty years before he had had typhoid fever; twenty years before, rheumatic fever with cardiac involvement. Venereal infection of any kind was denied.

The present illness began with an attack of "influenza" three months prior to admission of the patient to the hospital. The patient had had fever, slight chills and symptoms of a cold in the head for about one week. A few days later he complained of pain in the right ear; a myringotomy was then performed, following which pus continued to discharge from the ear for some time. Thereafter up to the time of admission to the hospital, the patient had felt below par.

About ten days before admission, the patient awoke one night with severe pain in the lower abdomen, mostly on the left side, shooting down into the thigh. At the same time he noticed a tender swelling in the left groin, which gradually increased in size. There were slight chilly sensations, moderate fever and malaise.

On examination in the hospital, a firm tender swelling was found in the left groin, cylindrical in shape and corresponding to the shape, extent and direction of the spermatic cord. The left half of the scrotum was slightly reddened but the testis and epididymis felt normal. There was a difference of opinion as to whether a mass could, or could not be palpated in the pelvic cavity by rectal examination. There was no urethral discharge; no enlargement or tenderness of the prostate or vesicles. In addition to these local findings, there was a chronic suppurative otitis media on the right side with perforation of the membrana tympani; also a compensated mitral insufficiency.

On the day of admission to the hospital, the patient's temperature was 102° F. The blood examination showed a leucocytosis of 42,000 with a polynucleosis of 92 per cent. The urine contained albumin, casts and a few white cells. The urine was not purulent.

The pre-operative diagnosis was abscess of the abdominal wall. At operation the inguinal canal was opened throughout its entire length and the spermatic cord was found thickened to a diameter of four centimetres, with all of the structures matted together with inflammatory and doughy exudate. There was no fluid pus present. Aspiration of the deeper structures also showed no fluid pus. A small tube was left in the canal and the outer wound was closed down to the point of

emergence of the tube. Aspiration, for exploratory purposes, was done through the rectum at a later date but with negative results. There was practically no discharge from the wound and the latter healed uneventfully. The pain and swelling in the groin decreased at first and, later, disappeared entirely.

During the convalescence some slight pain and swelling appeared in the right groin; this was transient and disappeared after several days. At the end of the second week the patient was discharged from the hospital cured of his ailment.

An attempt was made to find a possible etiological factor; but, in this, we were unsuccessful. Smears from the cord structures showed only a saprophytic Gram-positive bacillus and pus cells. The prostate was massaged and the material thus obtained showed numerous Gram-positive lancet-shaped diplococci in short chains in addition to a few clumps of pus cells. Culture of this material yielded only a hemolytic staphylococcus albus in pure culture. Smears of the pus from the right ear were negative; and the blood complement fixation test for gonococci was also negative.

Somewhat similar to the above case is the one described by N. R. Smith in 1834 in the *Archives of the Medical and Surgical Sciences*. Apparently this is the only reference to this subject which we have been able to find in the American literature up to the present writing. The case described is of a "morbid state of the spermatic cord simulating hernia" occurring in a young man.

The patient had been complaining of a painful swelling in the left inguinal region for three days. In addition, there were other symptoms, including vomiting, which suggested the diagnosis of strangulated hernia. There was some edema of the scrotum and a distinct swelling along the course of the left inguinal canal. An incision was made as for a strangulated hernia, but, on exposure of the cord, it was found to be greatly enlarged due to "infiltration of serum into its layers." The patient did poorly after operation and died the next day. At the post-mortem examination in addition to the local findings, there was found signs of "peritoneal inflammation." No mention is made of the gonococcus as a possible etiological factor.

It is possible that the sero-fibrinous inflammation present in the preceding two cases may be only one phase of a more severe process. A more virulent infection or a lowered resisting power on the part of the patient would then lead to the development of pus with abscess formation, confined at first to the cord, and spreading later to the surrounding structures. These cases might be classified as "acute funiculitis with abscess formation." Such a case, apparently, is the one reported by Hamilton in 1844. The clinical picture was typical of acute funiculitis and at operation a localized abscess of the cord was found. Hamilton believed that the abscess had occurred as the result of infection of an encysted hydrocele of the cord; the etiological relationship is rather of a theoretical nature in the absence of more substantial proof. No organisms were recovered from the pus. In another case of acute suppuration of the cord described by Dupraz the colon bacillus was isolated from an extensive foul-smelling abscess.

As an illustration of the manner in which a primary suppuration of the spermatic cord may spread, the following clinical notes are given; we are indebted to the service of Doctor Beer for them:

Hospital No. 209001. A forty-nine year old man was admitted to the hospital complaining of a painful swelling in the right groin of 5 weeks duration. Except for an attack of gonorrhoea, thirty-one years before, there had been no preceding illness. The pain in the groin soon extended to the scrotum and three weeks before admission to the hospital, perforation of the latter organ occurred with the discharge of pus. There was only slight fever and no vomiting. Upon admission to the hospital there was found a tender fluctuating mass in the right groin and the cord was thickened and tender. The epididymis also felt firm and tender and by rectal examination a tender mass could be palpated above the prostate.

At operation, pus was found superficial to Poupart's ligament coming through the external ring. On opening the canal the cord was found to be greatly thickened and inflamed; the vas deferens, nodular and beaded. A second abscess was found beneath the external oblique muscle extending upwards for about four inches. The pus was evacuated and the cavity packed with iodoform gauze. At the end of three weeks the wound healed completely; the nodular thickening of the vas deferens disappeared and the scrotal sinus had closed.

Smears and cultures of the pus were negative bacteriologically. The Wassermann reaction was also negative. The importance of the gonococcus infection as an etiological factor is extremely problematical.

Comment.—The third group of cases of deferentitis and funiculitis—those of indeterminate nature—is extremely interesting because of the entire lack of evidence pointing to a satisfactory etiological cause. Among the factors to be considered are (1) trauma, (2) a preëxisting infectious disease such as rheumatism or influenza, and (3) the presence of any focus of infection and suppuration to which the funiculitis might be considered as a metastatic phenomenon.

1. Does trauma play any rôle in the etiology of the cases in this group? Turner, in 1886, described a case occurring in a three months' old child who had been kicked in the scrotum a few days before the development of a painful, tender, fluctuating swelling in the groin. This was incised, pus was evacuated from the inguinal canal and, thereafter, the wound healed uneventfully. To be sure, this is an isolated case; and in none of the others did there seem to be such a close relationship to a preceding trauma.

2. French writers mention, but do not go into further detail or discussion of rheumatic fever and gout as etiological factors in funiculitis. It is true that our first patient gave a history of an attack of rheumatic fever and that a cardio-valvular defect was present; but the interval of time between the latter and the funiculitis makes the etiological connection rather weak; and, during the course of the lesion in the cord, there was no clinical evidence of any possible associated rheumatic manifestation.

In our first case there was a history of an attack of "influenza" three months before the onset of the pain and swelling in the cord. It is, of course, possible, too, that the influenza becomes operative as an initial focus because of the development of some intermediate lesion, such as a middle ear infection. However, this, also, is an isolated instance.

In any case, therefore, the value of any infectious disease as an etiological factor in connection with any case of funiculitis is extremely problematical because of the paucity of laboratory, clinical or other evidence.

3. The possibility of the funiculitis occurring as a metastatic infection secondary to another suppurating focus—in our case a middle-ear infection—must also be considered. In our experience at the hospital, metastatic foci of this kind secondary to middle-ear infections are extremely rare, except when a sinus thrombosis is present. In our patient there was no clinical evidence of such a complication. In addition, bacteriological examination of the ear was negative and the smears of the cord showed only a saprophytic organism which was most likely a contaminant. Evidence in this regard is, therefore, also, lacking.

Differential Diagnosis.—The differential diagnosis of acute funiculitis of this type is extremely difficult at times. Clinically, funiculitis may simulate any number of varied surgical conditions, and the surgeon may be confronted with unexpected findings when operating upon a patient with a swelling in the groin. The following conditions must be borne in mind and differentiated before arriving at a diagnosis.

1. Abscess of the abdominal wall. This is a very common diagnosis made before operation in cases of acute funiculitis. This was the circumstance in both of our cases. A localized collection of pus may occur at any point of the abdominal wall. Such an abscess may be of any size; may be subcutaneous; or may be in the deeper layers of the abdominal wall. If an abscess does form in the groin, its extent and direction with relation to the inguinal canal must be considered in arriving at a diagnosis.

2. Irreducible hernia. In the endemic type, this was the most frequent pre-operative diagnosis made, because of the similarity of the symptoms and physical signs at the onset of both conditions. In both cases there is usually a tender swelling in the groin with absence of impulse on coughing. However, in cases of irreducible hernia the tenderness is more apt to be localized to the neck of the sac. In funiculitis the tenderness will extend along the entire length of the cord and may even be elicited from the epididymis of the corresponding side. In neither condition need there be any appreciable change in the overlying skin. Redness and edema may be entirely absent. The presence of fever and leucocytosis favor the diagnosis of an inflammatory process. In the severe cases of funiculitis with rapid onset, vomiting and persistent constipation are prominent symptoms and are of such intensity as to resemble acute intestinal obstruction. One can see how, with the addition of the local findings, a diagnosis of irreducible hernia with ileus can be incorrectly made.

Where acute funiculitis is suspected and a history of a preëxisting hernia on that side is obtained, the former diagnosis cannot be ruled out because in some of the cases reported in the literature an inflamed hernial sac has been found in addition to the inflammation of the spermatic cord. In the case described by Jones, both conditions were present, namely, funiculitis and an irreducible hernia on the same side.

3. Appendicitis with abscess. If the swelling of the cord is rather high up towards the internal inguinal ring, it may very well be mistaken for a mass in connection with an acute appendicitis. In the latter condition such a mass can be produced by a thickened omentum rolled around an inflamed appendix, or by a localized abscess. The symptoms and history may be the same in both conditions. Rectal examination would not be of much aid in the differentiation because in either condition there may be nothing more than a slight tenderness, due, in the case of appendicitis, to the low-lying appendix, or appendicular abscess, and, in the case of funiculitis, to the involvement of the vas deferens in the inflammatory process. However, a tender, well-outlined, definitely thickened vas deferens felt by rectum, together with the swelling in the groin, is more in favor of a spermatic cord involvement.

4. Abscess in a hernial sac. Another condition, though of greater rarity, that may cause difficulty in diagnosis, is the occurrence of an abscess forming in a hernial sac. Such an abscess may have an acute appendicitis as the primary cause, or a segment of gangrenous omentum, or twisted epiploic appendage. It seems quite evident that the correct diagnosis in these cases is to be made only at operation unless some other factor, capable of giving one a correct clue, is present.

5. Thrombosis of varicose veins of the cord. The clinical picture and pathological anatomy of the condition described under the third grouping in this communication is not a thrombosis of blood-vessels. The latter would produce a thickening of the cord without sign or symptom of an inflammatory process. Also, varicose veins would have been present before the onset of the acute illness.

6. Hematoma of the cord. A history of trauma and the absence of inflammatory changes would favor such a diagnosis. An abscess might, however, develop later as in the case reported by Turner.

7. Tuberculosis of the vas deferens. Tuberculosis may be associated with secondary changes in the cord. There is usually an advanced lesion in the epididymis. This is a chronic illness.

8. Gumma of the cord. The course is chronic. The cord is, as a rule, not tender. The Wassermann reaction of the blood is positive. With the administration of appropriate antiluetic treatment the swelling diminishes.

9. Neoplasm of the cord or in the inguinal canal. Various neoplastic formations occur in the cord. It is not necessary to go into a detailed description of them here. Suffice to say, that one ought to recognize the differences in the duration of the illness and the differences in the local findings. However, an infected neoplasm of the cord could give considerable difficulty in diagnosis.

10. Osteomyelitis or infected neoplasm of the os pubis must also be considered in the differential diagnosis. The roentgenographic findings aid in the differentiation.

11. A psoas abscess can appear in the groin and conceivably be mistaken for a funiculitis. The röntgenographic evidence and clinically objective findings should suffice to make the correct diagnosis.

Treatment.—In the gonorrhœal cases, where no pus has formed, operative interference is contra-indicated. Under conservative forms of treatment, as for any of the other usual gonorrhœal complications, the funiculitis usually subsides. Where, however, pus has formed, adequate incision and drainage is indicated.

In the endemic or tropical type, where the cord is riddled with small abscesses, complete excision of the cord is recommended; the wound should not be sutured, but kept wide open with gauze packings.

In the cases of indeterminate etiology, with or without abscess formation, incision down to the cord and evacuation and drainage of abscesses, whenever present, is indicated.

SUMMARY

Acute deferentitis and funiculitis may be classified into three main groups: 1. Cases of gonorrhœal origin. 2. Cases due to streptococcus infection—an endemic type in tropical countries—the essential lesion being a thrombo-phlebitis. 3. Cases of indeterminate etiology with and without abscess formation.

Two cases of the third group are described. Both were operated upon and recovered uneventfully.

The importance of the differential diagnosis of this disease is emphasized.

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TRANSPUBIC REMOVAL OF THE PROSTATE FOR CARCINOMA

BY GEORGE WALKER, M.D.

OF BALTIMORE, MD.

IN the ANNALS OF SURGERY of May, 1921, I suggested a preliminary symphysiotomy in the removal of cancer of the prostate. I had carried out



FIG. 1.—Initial incision.

this operation a number of times on cadavers, and was impressed with its feasibility.

Within the past year it has been employed twice on human beings.

The following steps, somewhat modified from the original publication, were carried out:

1. Make an incision from one inch below the umbilicus to a point over the middle of the pubis, as is shown in Fig. 1.
2. Expose the bladder in the same manner as in an ordinary supra-pubic operation.

3. Open the bladder to confirm the diagnosis and to ascertain the extent of the invasion of the vesical neck. (See Fig. 2.)

4. Cut through the cartilage joining the pubes, and separate the bones slightly. Then divide the pubic ligaments and attachments of the triangular ligament. This should be done with a blunt-pointed knife.

5. Place the special retractor between the cut ends of the bone and

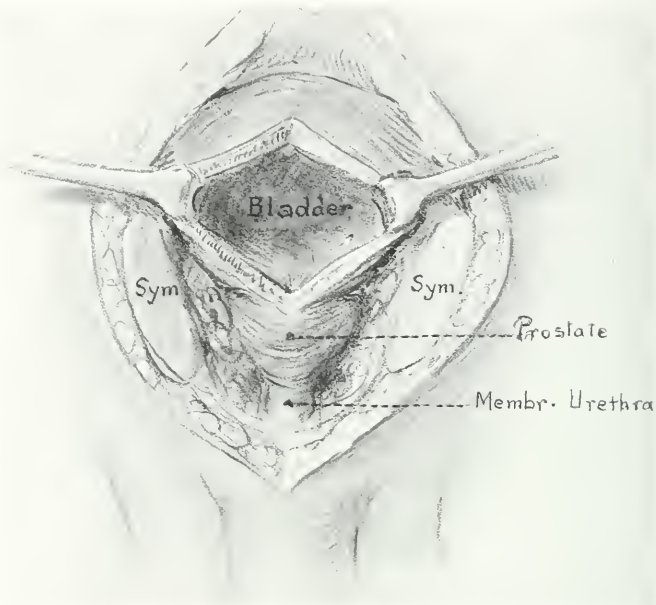


FIG. 2.—Bladder opened for confirmation of diagnosis and for invasion of vesicle of neck.

separate the surfaces as widely as desired. Abduction of the legs aids the separation. (See Fig. 8.)

6. As the bones are separated, the prostate comes into view. The lateral surfaces of the gland are then freed from the surrounding tissue by the operator's hand. This separation is carried down to the rectal wall.

7. The urethra is now cut across at its juncture with the prostate.

8. The prostatic end of the urethra is grasped with the forceps and pulled upward and forward so as to allow the prostate to be dissected, under view, from the rectum. This should be done with great care. The dissection is carried well up toward, but not quite, to the bladder.

9. Divide the bladder transversely as near the vesical neck as is war-

ranted by the growth. Our aim should always be to leave the thickened band of muscle which forms the internal sphincter.

10. After the circular incision of the bladder, the remaining attachment of the bladder is carefully divided. (See Fig. 3.)

11. Suture the cut end of the urethra to the posterior angle of the wound with 28-day cat-gut, as shown in Fig. 4.

12. After the preliminary posterior suture pass a catheter and complete the sutures around it (Fig. 5).

13. Close the bladder from the juncture of the urethra upward, leaving an opening three-quarters of an inch in length for the reception of a drainage tube (Figs. 5 and 6).



FIG. 3.—Shows cut ends of urethra and bladder and cavity from which prostate was removed.



FIG. 4.—Preliminary suture approximating cut end of the urethra to posterior angle of wound of bladder.

15. Place the proper drain and close the wound.

After-care: When the patient is removed from the operating table he

14. Close the symphysis with heavy silver-wire (Fig. 6). In both of these two patients the wires failed to hold; hence it is thought that a snugly fitting binder made of stiff cloth and buckles would answer the purpose better. In the case of a recent patient (not carcinoma) only the binder was used, and the recovery and union were satisfactory. The binder, shown in Fig. 7, has been found quite suitable.

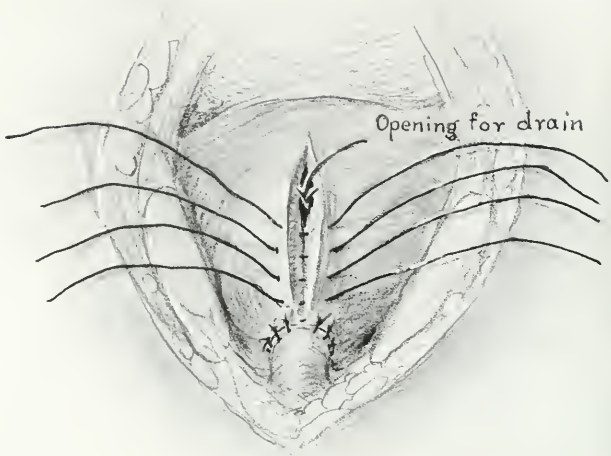


FIG. 5.—Completion of urethra and bladder suture, with sutures placed for partial closure of bladder.

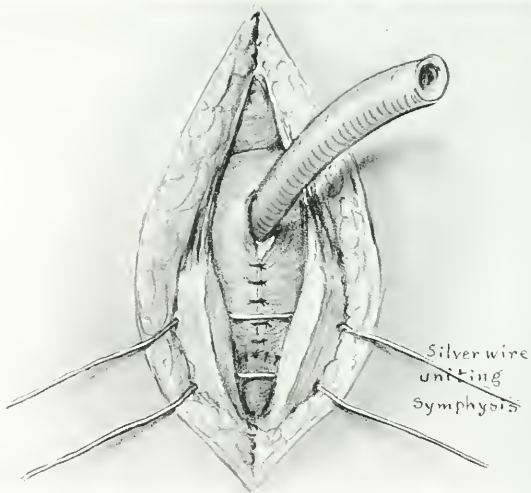


FIG. 6.—Close bladder; rubber drainage tube; two heavy silver wire sutures for closure of pubes.

TRANSPUBLIC REMOVAL OF THE PROSTATE

is put on a Bradford frame, and is kept as immobile as possible during the first week.

The catheter is allowed to remain in for ten days or two weeks, unless

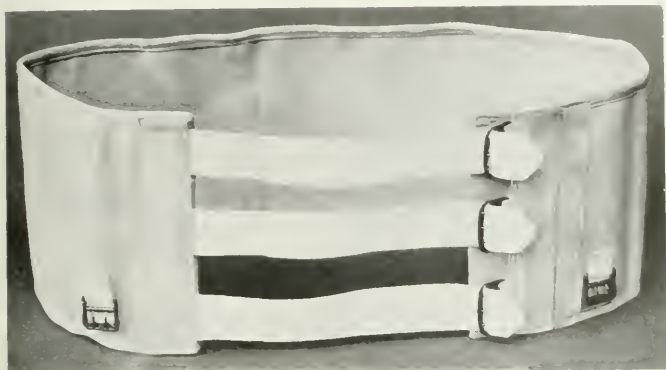


FIG. 7.—Binder while put on immediately after operation.

it gives trouble. The bladder is irrigated on the second day with warm saline solution. This irrigation is repeated every day.

When the catheter is taken out, a sound is passed every third or fourth day until the wound has healed.

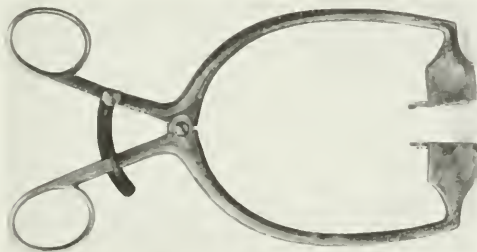


FIG. 8.—Retractor used in separating pelvis.

The patient may be up on a back-rest at the end of two weeks and lifted out of bed to a wheel-chair at the end of the third week.

The binder is kept tight all the while. Especial care should be taken of the patient's back; that is, the binder should be loosened and the skin under it cleansed and rubbed with alcohol twice daily.

Report of Cases.—J. Y. M., aged sixty-two, had had pain and frequent micturition for six months, but looked well and had not suffered any loss in weight. The urine contained white and red cells. The prostate was small and very hard. The surface was smooth, and there was no evidence that the growth had

broken through the capsule. The vesicles were normal. The diagnosis of carcinoma was based upon the hardness of the gland. Cystoscopic examination showed no invasion of the bladder. X-ray examination did not disclose any metastases to bone.

The operation was carried out as above described. Unfortunately, just at the end, a sharp clamp which had been left on a vessel was found to have pushed through the rectal wall and to have made a wound about half an inch in length. This was sutured but it afterwards broke down, causing a flooding of the wound with fecal matter, which continued for about three weeks.



FIG. 9.—Prostate of patient No. 1. Piece of wood placed in urethra.

In spite of the fecal infection the wound healed rapidly. The wire sutures did not hold and were removed. The patient was allowed to be up on his feet at the end of four weeks. He began to void on the thirty-third day. He left the hospital for his home in Florida at the end of the seventh week. At that time he was voiding quite naturally from four to six ounces each time. There was a slight leakage from the suprapubic wound but none from the urethra. A treatment of radium was given as a precautionary measure.

Six months after the operation the patient had gained fifteen pounds; he looked ruddy and healthy, voided normally six ounces at a time; the suprapubic and rectal wounds had entirely closed. Figure 9 shows a photograph of the prostate. On section it was found to be almost completely transformed into a carcinomatous mass.

J. B. P., aged fifty-seven, had had frequent and somewhat painful micturition for one year, and at intervals he had complained of general discomfort and pain in the lower part of the back. He had not lost weight and his general appearance was good. The prostate was hard and firmly fixed, but the surface of the gland was smooth. There were no nodules, and the vesicles were normal. Cystoscopic examination showed that the bladder was not invaded. X-ray showed no metastases to bone.

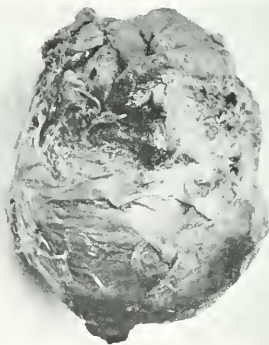


FIG. 10.—Prostate of patient No. 2.

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The operation was more easily done than the one on the first patient. The steps were the same. The patient made an uneventful recovery and went to his home in Tennessee at the end of the fifth week. The suprapubic wound had not entirely closed and there was still some leakage, but he was voiding normally from three to five ounces every three to five hours. There was no leakage by the urethra. Prostate is shown in Figure 10. On the transverse section there is a central area of carcinomatous tissue about the size of a hazel nut.

The patient came back six months after the operation for inspection. There was no evidence of any return. He had gained 20 pounds in weight and looked robust. There was still leakage from the suprapubic wound, but he could hold and void seven ounces. Sounds up to No. 28 were passed and, since some scar tissue was in evidence, he was directed to have this procedure continued every ten days for two or three months.

Patient No. 1 returned for inspection on May 15, 1923. He expressed himself as being perfectly well; has not the slightest evidence of recurrence. Voids urine normally; many times does not have to get up at night.

Patient No. 2 returned June 25, 1923, on account of leakage of suprapubic fistula; in apparent robust health; there is no recurrence. Voids five or six ounces every three or four hours; has no dribbling from urethra.

Both of the above operations were done on my request by Dr. J. M. T. Finney. I beg to thank him very kindly for his services and for valuable suggestions in procedure.

N. B.—Since writing the above, Case II has returned with unmistakable evidence of local recurrence.

THE CONTROL OF HEMORRHAGE FOLLOWING PROSTATECTOMY

By HAROLD L. FOSS, M.D.

OF DANVILLE, PA.

SURGEON-IN-CHIEF, GEBINGER MEMORIAL HOSPITAL

SURGEONS will generally agree that controlling bleeding following suprapubic prostatectomy is a step in the operation frequently causing no little concern and one to which considerable attention must be paid in every case. Many devices to facilitate hæmostasis have been suggested from the simple gauze pack to inflatable rubber bags of the Hagner type, certain of which are being used successfully by many surgeons. The simple procedure of

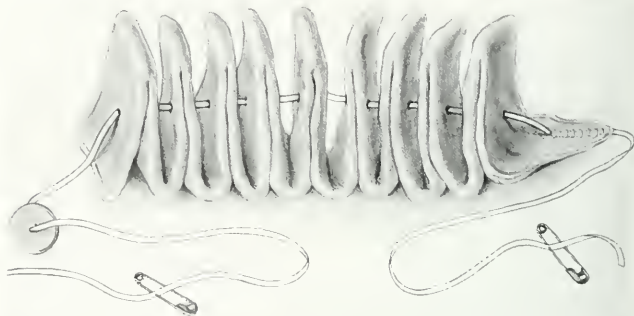


FIG. 1.—Suprapubic prostatic pack.

carefully suturing the prostatic capsule is depended on by men who dislike resorting to mechanical devices for the control of the bladder hemorrhage and with ample time and good exposure such means prove quite satisfactory. The desirability of performing the operation with as great celerity as is compatible with good surgical work and the necessity of operating through a small bladder incision renders careful ligation or suturing often very difficult. Gauze under pressure has always been a popular hæmostatic agent in many operative fields and when packed into the prostatic fossa will, for a time at least, control severe oozing. Its tendency, however, to float away as soon as the bladder fills with urine, renders the effect of the simple pack but a temporary one and so various methods have been evolved of holding the gauze firmly in place until permanent closure of the vessels has taken place.

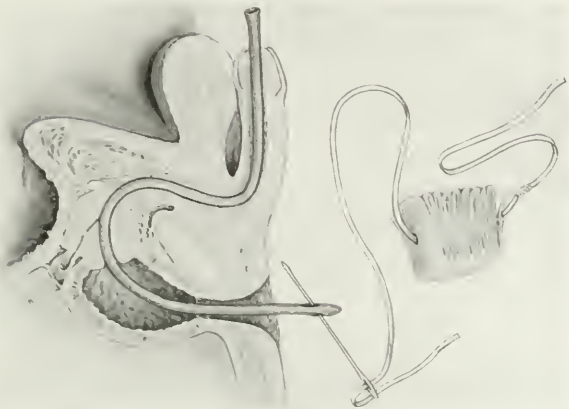


FIG. 2. Catheter passed. Tape threaded through eye.

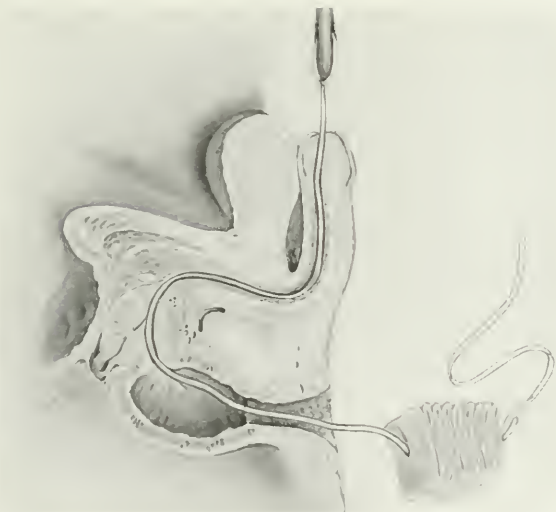


FIG. 3. Catheter withdrawn, tape brought out through urethra. Pack laid aside while prostatectomy is being performed.

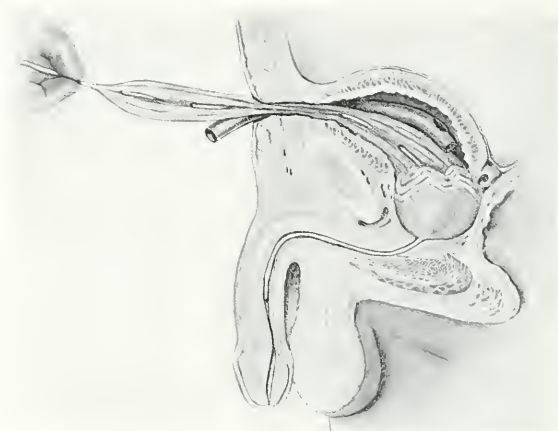


FIG. 5.—Urethral tape cut. Pack being withdrawn.

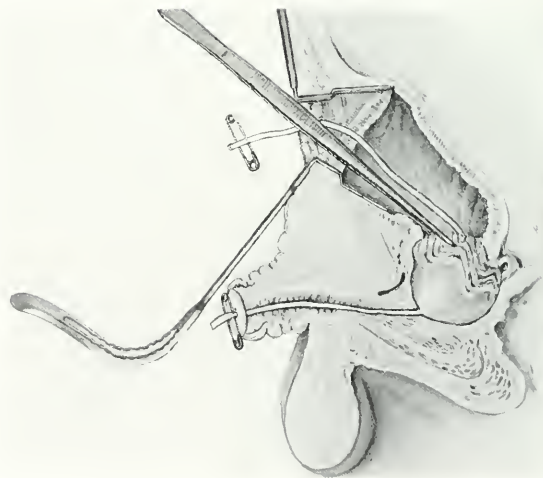


FIG. 4.—Prostatectomy completed. Pack placed in capsule. Tape tightened and secured.

For several years I have been using an accordion plaited gauze pack, through which a tape is threaded in such a manner that when brought out through the urethra and secured against the glans penis, the pack is drawn snugly in the form of a cone into the prostatic cavity and there held firmly in place. A second tape projecting through the suprapubic wound renders the removal of the pack a simple matter, easily and quickly accomplished. With this device hemorrhage is immediately controlled and the bladder rendered absolutely dry before closing.

The pack is constructed of four layers of surgical gauze and unfolded, measures fifty-five inches in length and four inches in breadth. A piece of strong tape is stitched in place, as shown in the accompanying illustration, and following the operation is brought out through the urethra and held snugly in place by means of a safety pin and large button.

Before commencing the operation a catheter, with double eye, is passed into the bladder and on opening the latter the tape is threaded through the eyes and its end withdrawn through the urethra. A hæmostat snapped on the end of the tape prevents it being drawn back into the bladder. The pack itself remains folded in a towel out of the way until the gland is removed, when it is guided into the prostatic cavity by means of long dressing forceps, the urethral tape drawn tightly and the hemorrhage immediately checked. A suprapubic tube is placed in the bladder before the wound is closed. In forty-eight hours the urethral tape is cut and, after a whiff of NO_2 has been administered, the pack is withdrawn by means of the suprapubic tape. The tube is then removed, the wound tightly closed with two deep silkworm sutures, and a urethral catheter passed and secured in place.

No doubt similar schemes have occurred to other men and, possibly, many such are in daily use. I had been using the pack in prostatectomies for several years without knowing of it being resorted to elsewhere until the appearance of Doctor Farr's paper in which he describes a similar device. The pack has proven so helpful in my own work that a detailed description of its construction and method of application seems not altogether out of place.

This means of controlling post-operative hemorrhage following prostatectomy has been used routinely in my cases for the past seven years with utmost satisfaction. In no case has there been the slightest hemorrhage and in none evidence of urethral irritation, while the healing of the suprapubic wound has been prompt and satisfactory.

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FRACTURE OF THE ACETABULUM WITH CENTRAL LUXATION OF THE HIP

BY SAMUEL KLEINBERG, M.D.

OF NEW YORK, N. Y.

FRACTURE of the acetabulum unassociated with extensive injury of the pelvis and pelvic organs is comparatively rare. There are no available statistics to indicate the relative frequency of this injury among fractures. In fact, it is only in recent years that the lesion has been recognized and reported. This is probably so because the clinical picture resembles closely that of other injuries, as for example, contusion of the hip, and can be diagnosed with certainty only from a röntgenogram. Very likely there have been many more cases than are recorded, but, up to 1912, Vaughan was able to collect only twenty-six undoubted cases, and since then, Peet has reported one case and reviewed fourteen others described by various authors. Dr. Royal Whitman in reporting a case of central luxation of the hip mentions that he has seen five others. Compared with fractures and dislocations in other regions this lesion is surely an infrequent one.

The terminology used in this condition is somewhat confusing. It is described by some as a fracture of the acetabulum, by others, as central luxation of the hip, central or intrapelvic displacement or dislocation of the femoral head. There are actually two distinct lesions, a fracture of the acetabulum and an inward displacement of the femoral head. Both lesions vary in degree. The extent of the displacement of the femoral head depends upon the severity of the fracture of the floor of the acetabulum, and the distance to which the fragments are driven inward. The injury results from a force acting upon the great trochanter. The head of the femur driven inward shatters the acetabulum, forces its fragments into the pelvis and thus becomes dislocated. The primary lesion is, therefore, a fracture of the acetabulum. The secondary resultant condition is the displacement or dislocation of the femoral head. The latter, however, is responsible for the ultimate disability and it is to the correction of this, the dislocation, that treatment need be directed. The fracture of the acetabulum, except in very rare cases, cannot be treated because of the inaccessibility of the parts. I am at this moment excluding from consideration those cases in which there is an injury of the pelvic structures by the fragments of the acetabulum requiring intrapelvic exploration. At such an operation manipulation of the fragments into proper alignment may be possible. Usually in an injury of this kind, which is severe and dangerous, the condition of the pelvic organs is so grave and the general condition of the patient so poor that the associated injury of the hip must necessarily be overlooked for a long time. As in fractures of other bones, so in acetabular fractures, the fragments may not be displaced at all; or they may

be moderately disarranged and driven inward without dislocation of the femoral head, or the fragments may be pushed inward considerably and the femoral head dislocated into the pelvis. Ochsner divides this injury accordingly into three distinct types: (1) a fissured fracture with no displacement; (2) multiple fracture and inbending of the acetabulum; and (3) complete dislocation of the femur through a badly shattered acetabulum—central dislocation of the hip. It would appear to be best, therefore, to describe these cases under the title of fracture of the acetabulum with or without central luxation of the hip.

Two factors militate against the more effective control of this lesion. One is that at times the injury results in such severe shock or extensive and dangerous involvement of the bladder, intestines, blood-vessels or other pelvic organs that although, one may be aware of the lesion in the hip, it is impossible to apply treatment for its relief until many weeks afterward. The other is failure to recognize the nature of the lesion. The fact that in many of the reported cases the patients were not seen until several weeks and even months



FIG. 1.—Case 1. I. C. Fracture of the acetabulum. Inward displacement of the middle two-fourths of the floor of the acetabulum. Femoral head not dislocated.

after the injury attests to the frequency of the latter unfortunate occurrence. After such a lapse of time it is difficult to apply curative measures which would be easily carried out immediately after the injury.

There are no distinctive or pathognomonic features in the clinical appearance of the patient which may assist one to make a diagnosis, but there are several very suggestive findings. The most important of these is a sunken appearance of the great trochanter (Fig. 3). In the ordinary congenital or acquired dislocation of the hip the great trochanter is abnormally prominent. In fractures of the upper extremity of the femur or of the pelvic bones, except that of the acetabulum, the normal prominence of the trochanter remains. In this injury, however, there is a flattening of the hip which is comparable to that of the shoulder in subglenoid or subcoracoid dislocations. Because of the

naturally bulging and fleshy appearance of the hip, slight flattening may not be evident; but when recognized, it forms an important guide to the diagnosis of central dislocation of the hip. A direct blow over the hip may, of course, cause a variety of traumatic lesions in and about the hip, but in a case in which there is a history of such an occurrence and none of the characteristic signs of other lesions, such as dorsal dislocations, fractures of the neck of the femur, fractures of the great trochanter or shaft of the femur, fractures of the ilium or



FIG. 2.—Case II. M. C. Fracture of the acetabulum. Inward displacement of acetabular fragments and head of femur. Great trochanter is in contact with the ilium.

ischium, separation of the symphysis pubis and so forth, fracture of the acetabulum with central dislocation of the hip should be thought of. Persistent pain and disability in the absence of evidence pointing to such lesions as have just been enumerated, should lead one to suspect a central luxation of the hip. Simple contusion of the hip, even if very extensive, rarely results in prolonged pain and disability.

As a matter of fact, now-a-days, in a large city and in well equipped rural institutions the diagnosis would rarely be in doubt, for, in any extensive injury to the hip, an X-ray study would be routine. It is, however, worth while

to emphasize the fact

that a history of a blow over the hip, persistent pain, disability and flattening of the external surface of the hip jointly constitute strong evidence of a fracture of the acetabulum with central luxation of the hip. It is important to remember this clinical picture because there are still sections of the country which are lacking in complete modern X-ray equipment. Even in the city one is at times misled by poor röntgenograms. It has latterly become the practice among many physicians to have X-ray apparatus in their offices with little training in the art of X-ray photography. I have seen many pictures taken by inexpert men which were so poor and blurred that it was difficult to identify the gross outline of bones, much less the intricate structures

of the hip joint. Many general practitioners desiring to give their patients full service do their own X-ray work, but unless the plates are clear and the physicians have trained themselves to read them, they do not render their patients a service, but, on the contrary, may do harm because they do not obtain the proper information from the plates. I emphasize this point because I have had a goodly number of such pictures brought to me and am convinced that it is a pernicious practice which should be discouraged, especially in large medical centres where the best workmanship and talent are available.

The object of treatment is to reduce the dislocation. As most cases are seen some time after the injury, proper alignment of the broken fragments is out of the question. In the rare cases which are seen early some attempt at outward displacement of the acetabular fragments may be made. In females by introducing the hand into the vagina, one may be able to push the fragments into place. Doctor Grausman, of New York, related to me an interesting experience. He was called to see a case of fracture of the acetabulum in which there was a comminuted fracture with inward displacement of the fragments and of the femoral head. The patient was given a general anæsthetic. Doctor Grausman then stretched the rectal sphincter so that he was able to introduce his hand into the rectum and, as the fracture was on the left



FIG. 3.—Case III. M. C. Fracture of the left acetabulum and central dislocation of the hip. Note sunken appearance of left great trochanter, flexion and adduction contraction of the hip and atrophy of the left lower limb.

side, he reached toward the acetabulum, pushed the fragments outward and reduced the dislocation of the femoral head. In the average case, seen weeks after the accident, the fracture is healed and the pain and disability are due to the dislocation. Most surgeons have used longitudinal and lateral traction in the treatment of this dislocation and in many cases satisfactorily. Dr. Royal Whitman in his case successfully applied the abduction method. Using the great trochanter, which is usually in contact with the ilium, as a fulcrum and the thigh as a long lever he forced the femoral head out of the pelvis. This was

a case of long standing, and by means of the abduction method he was enabled to use the strong force necessary to dislodge the head of the femur. This method appealed to me as a logical procedure and superior to and more easily and accurately applied than the complicated and less certain method of longitudinal and lateral traction. Lateral traction in the thigh for hip conditions, such as fracture of the neck of the femur, has always appeared to me to be a very uncertain process, because of the technical difficulty of using any great amount of force accurately. In two of my cases in which the abduction method

was used the anatomical and functional results were good.

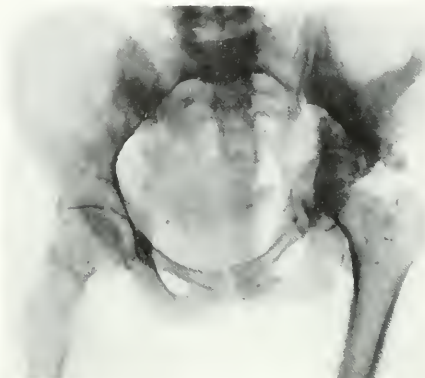


FIG. 4.—Case III. M. C. Note marked inward displacement of the acetabular fragments. Central luxation of the femoral head. Great trochanter abnormally near the ilium and the lesser trochanter near the ischium. Large mass of bone in the interval between the ilium and great trochanter.

CASE REPORTS

CASE I.—J. C., male, thirty-seven years old. This patient was seen in Doctor Whitman's clinic at the Hospital for Ruptured and Crippled and I am indebted to Dr. Arthur Krida for the details of the history and examination. The patient applied for treatment on April 24, 1923, complaining of disability in the right hip. Four weeks previously he fell from a truck, a distance of about 3 feet,

striking the shaft with the full force of his body against the hip and had to be lifted out. He has since been getting about, but with pain from which to date he has had no relief. He walked with the aid of a cane and with a marked limp on the right side. All motions of the right hip were very painful. The limb was held slightly flexed and adducted at the hip. There was marked tenderness of the hip. An antero-posterior X-ray picture, Fig. 1, showed a fracture of the acetabulum. The middle two-fourths of the floor of the acetabulum were displaced inward about an eighth of an inch. There was no appreciable displacement of the femoral head. Correction of the deformity was advised but the patient refused to submit to treatment.

CASE II.—M. R., male, thirty-two years old. He applied for treatment in the out-patient department of the Hospital for Ruptured and Crippled and was admitted January 13, 1922 to Doctor Whitman's service, where he came under my care. The history showed that 5 months previously he fell from an ice-wagon striking on the right buttock and outer side of the hip. He was unable to rise and was carried home. A diagnosis of contusion of the hip was made. He remained in bed for about 6 weeks because of pain in the limb. He then began to walk, but only with the aid of a cane, and with great discomfort and difficulty. The pain and disability persisted and he was relieved only by sitting down.

Examination showed that the man walked with a marked limp on the right

side, the body inclined forward and the right hip flexed. The trochanter was not prominent and not elevated. Extension of the hip was limited to 130 degrees, that is, 50 degrees short of the normal. Flexion was fairly free but all the other motions were restricted and painful. In the line of deformity RA measured 28½ inches and LA 29 inches. There was marked atrophy of the right thigh and slight atrophy of the right leg. An X-ray picture, Fig. 2, showed a fracture of the acetabulum with inward displacement of the acetabular fragment, and inward dislocation of the femoral head so that the trochanter was in contact with the ilium. There was also a fracture of the right pubic bone near its junction with the ischium. The rest of the pelvis was apparently normal.

Operation January 10, 1922. Under a general anæsthetic the right limb was forcibly stretched into extension and abduction until the deformity was entirely corrected and a plaster-of-Paris spica bandage was applied. A subsequent X-ray picture showed a marked improvement in the relation of the femur to the pelvis. About two weeks later I made a note to the effect that the patient had no pain and walked without assistance. The manipulative correction of the malposition of the femoral head and the change in the attitude of the limb resulted in an improved as well as painless function.

CASE III.—Mary C., thirty-five years old, was struck by an automobile on August 16, 1922. She was dragged along the ground for a short distance, sustaining an injury of the left hip. On account of severe and persistent pain in the hip she remained in bed for about 5 months. She received no treatment except baking and massage, and, although an X ray picture was taken, the nature of the injury was not diagnosed. Five months after the injury she began to walk with the aid of a cane. She had a marked limp on the left side and severe disabling pain. One month later I was consulted and she was admitted to the Hospital for Ruptured and Crippled.

Examination showed that she was thin, pale and in poor general condition. Showing the effects of prolonged suffering. Lying in bed the left limb was flexed and adducted at the hip. Turning in bed and handling of the limb was very painful. She was able to walk, but only with a cane and with a marked limp, pain and great effort. The left hip was flexed to 150 degrees and adducted 15 degrees. There was loss of the usual prominence of the great trochanter and a sunken appearance in this region which was especially noticeable in the upright posture (Fig. 3). Flexion of the hip was limited to 100 degrees. Abduction was entirely restricted. Rotation was limited and painful. There was very marked tenderness of the great trochanter. The right limb measured 29 and 18 inches from the anterior superior iliac spine to the internal malleolus and the left limb 28 and 5½ inches. The circumference of the right thigh was 18 and 18 inches and that of the left thigh was 16 and 3¼ inches. Vaginal examination revealed a large



FIG. 5.—Case III. M. C. Appearance of left hip after stretching and reduction of the deformity. The limb is in abduction and the femoral head and the trochanters are in their normal positions.

bony mass on the left side which was evidently the healed, inwardly displaced fragments of the acetabular floor. Movement of the femur was not transmitted to the bony mass in the vagina so that the femoral head had not penetrated into the pelvic cavity.

An X-ray picture, Fig. 4, showed a healed fracture of the acetabulum. The united fragments were displaced inward and formed a large bulging mass invading the pelvic cavity. The head of the femur was displaced inward so that the great trochanter was near the ilium and the lesser trochanter appeared to touch the ischium. There was a large fragment of bone between the ilium and great trochanter. The shaft of the femur was markedly adducted.

The immediate indication in the way of treatment was correction of the adduction and flexion deformity. If possible, the inward displacement of the femoral head was to be reduced. As the patient was almost completely disabled and was suffering much pain, treatment was imperative. She was, therefore, urged to submit to operation. Correction by forcible manipulation was to be tried first. If this was not successful, an open operation on the hip or an osteotomy of the femur was to be performed. On February 9, 1923 the patient was given a gas-oxygen anesthetic. The right limb was held firmly flexed at the hip and the left limb forcibly extended. Though great force was used the flexion deformity could not be corrected. The left limb was then forcibly abducted and with a crunching noise on the outer side and a tearing sound on the inner side of the hip, the limb was brought out into 35 degrees of abduction and complete extension. In this position a plaster-of-Paris spica bandage was applied. An X-ray picture (Fig. 5) taken sometime afterward showed not only an improved attitude of the limb, but also that the head of the femur had been brought out into its normal position, that is, the dislocation was reduced. The mass of bone between the great trochanter and the ilium had been crushed.

A few days after the operation the patient had no pain in the hip or limb and 6 weeks later she was discharged from the hospital, still wearing a short plaster spica, but with the deformity entirely corrected and no pain in the extremity. This case is interesting in demonstrating the effectiveness of the abduction method in reducing an old central dislocation of the hip. It seems to me that it would have been futile to have attempted to obtain any results by traction either longitudinal or lateral or both.

From a review of the cases reported in the literature and my own experience, the following observations may be emphasized: Fracture of the acetabulum with or without central luxation of the femoral head and not part of an extensive injury of the pelvis is a rare lesion. As there is a fracture of the acetabulum and a dislocation of the hip, the lesion should be described by the long, perhaps cumbersome, but descriptive title of fracture of the acetabulum with or without, as the case may be, central luxation of the femoral head. The history of a blow over the great trochanter, marked tenderness of the hip and a flat or sunken appearance of the great trochanter should suggest the likelihood of a fracture of the acetabulum with central luxation of the femoral head. An X-ray picture should be taken as soon after the injury as possible. This, if clear, will indicate the exact nature of the lesion. The ideal treatment is immediate reduction of the dislocation and immobilization in abduction. The reduction may be accomplished by the abduction method, which permits the effective use of the thigh as a strong lever over the great trochanter as the fulcrum.

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SCLERODERMA WITH GANGRENE OF FINGERS

REPORT OF TWO CASES

By HARRY COHEN, M.D.

OF NEW YORK, N. Y.

EXTENSIVE research into the literature shows that although the causes of gangrene, especially of the extremities, have been described very thoroughly, the two cases to be reported demonstrate another etiologic factor apparently not mentioned. This is the mechanical compression of the vessels caused by too tight-fitting skin, the etiology in these cases being scleroderma.

CASE REPORTS

CASE I.—S. G., age, twenty, male Russian. Five years ago first noted trouble in fingers of right hand. A few weeks later in the right elbow. Eight months ago, two fingers of the right hand and two fingers of the left hand simultaneously. At the same time he began to complain of pain in the index finger of the left hand, this terminated with gangrene and the index finger was operated on. Shortly afterward had middle finger amputated and since then the fourth finger of the left hand was affected in the same way. Pulsation, strong. Wassermann negative.

Briefly stated several important facts are brought out in this short history. His age, his nationality, simultaneous affection of right and left hand, swiftly spreading gangrene uncontrolled by amputations, pulsation strong and Wassermann negative. The strong pulsation at once ruled out Raynaud's disease. He was admitted to the Peoples Hospital, December, 1917. Having had a short time previously the right middle finger amputated at the second joint elsewhere. As the gangrene kept increasing further amputations were recommended.

Examinations showed that locally the tips of all fingers were necrotic, but most of the lesions were in the right hand, which was swollen and discolored. The middle finger had been amputated at the second joint, the bone was protruding from the distal portion and the fleshy part was gangrenous and swollen. He also had necrotic (trophic) ulcers over the head of the metacarpal bones and over the olecranon processes. Generally he presented all the lesions of an advanced general scleroderma; tight dry skin over the face, drawn features, considerable difficulty in opening his mouth, his eyelids drawn, the skin over his chest tight and drawn, likewise the skin over his lower extremities. His Wassermann was negative. The remaining stump was amputated and he was given hypodermic injections of pituitrin. This with local applications of chlorazene paste checked the tendency of the gangrene to spread. Not only did the gangrene in all the finger tips clear up but also the ulcers over the knuckles and at the elbows. At present although there has been a considerable improvement in both his general and local condition, still there has developed a more or less permanent flexion of the fingers of his left hand resulting in a typical sclerodactylia.

CASE II.—Mrs. B. D., age twenty-eight, Russian, seen first, November 27, 1921, representing gangrene of the tips of all fingers. In addition to this a general examination revealed an extensive scleroderma, most marked in the face. The mouth could be opened with difficulty and even the eyelids were considerably affected. The skin over the chest, arms, legs and feet was so tight that it could not be lifted into folds. Pituitrin 1 c.c. hypodermically once a day, for about two

weeks, caused the gangrene on the finger tips to disappear and also resulted in a relaxation to a marked degree of the entire cutaneous surface. This was most marked in the face and especially about the mouth. The improvement (not cure) in each case has been more or less permanent, treatment being continued for a period of one or two weeks each winter.

Besides the surgical gangrene and the skin condition of scleroderma, there were concomitant signs of endocrinological disturbance, for a study of which these patients were referred to Dr. Hyman Goldstein, who has made the following report:

Observations on Case I.—S. G. Weight, 98 pounds, height, 62 inches, pulse 96, systolic blood-pressure 100, diastolic 50. Body measurements and female hair distribution indicate adrenal domination in growth. His small tapering head and facial expression is like a marasmic child grown to adolescence. He has a small, narrow palatal arch, small incisors and canines with four artificial teeth. The skin of the following regions, bridge of the nose, forehead, molar regions, about the mouth, chest, scapulae, lower abdominal region, extensor surfaces of elbows and the hands, is rigid, glossy and goose-like. These areas show also bronze-like discoloration with positive Sergent's reaction. There is also marked flexor contracture of the left little, index and ring fingers. These findings and history of the case with such marked circulatory and skin dystrophic condition and positive Sergent's line with marked asthenia is evidence of a hypoplastic dyscrinism of hypoadrenal predominance, dyspituitarism and hypothyroidism.

Observation on Case II.—Mrs. B. D. Weight, 143 pounds, height, 63 inches, pulse 120, systolic blood pressure 100 and diastolic 45. Lungs normal. The heart is enlarged to the right, mitral presystolic murmur, muffled first apex sound and subclavian hum. Hair is scanty on scalp and outer third of eyebrows. Pupils are markedly dilated and react sluggishly to light and accommodation; vision is markedly myopic. Pharyngeal, superficial and deep reflexes exaggerated. Hands are cold and skin hard and dry, fingers and nails show trophic changes of sclerodermal type. Neck reveals a moderate size isthmus-thyroidæ undoubtedly of colloidal type. The skin is indurated and thickened showing marked trophic changes particularly in the tufts of the fingers, cracked at the phalangeal joints dorsal surface. Rough and rigid about forehead, chest, back, extremities, nose and lips. Difficult to open mouth widely. Her mentality is sluggish and she suffers from lapses of memory. At present she has a compensatory parenchymatous hyperthyroidism, which in these cases often alternates with periods of hypothyroidism and an hypoadrenia dyspituitarism and dysovarism of the hypo-functioning type.

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THE DISABILITIES OF THE HAND AND THEIR PHYSIOLOGICAL TREATMENT*

By HENRY H. M. LYLE, M.D.,
OF NEW YORK, N. Y.

Anatomical and Physiological Considerations.—The hand is such a complicated organ that a knowledge of its structure and function is essential to the successful treatment of the individual lesions. In the treatment we must not lose sight of the fact that the hand, in addition to being a marvelous mechanism



FIG. 1A.—Four months after an infectious arthritis of the carpus. A stiff useless hand. Note the position of wrist and fingers fixed in extension.

capable of the most delicate and intricate movements, is also a highly specialized sense organ.

The Position of Rest.—(Physiological balance.) In the mechanism of animal life it is a universal law that periods of activity are followed by periods of rest. The normal physiological position of the hand is simply an expression of the state of rest of the muscles, joints, nerves and vessels, the balance being maintained by the resting tone of the muscles. If you examine your own hand as it hangs by your side you will find that the arm is slightly pronated, the wrist dorsi-flexed, the palm hollowed and the fingers bent toward the palm. The little finger is flexed the most, then the ring next, then the middle, the index is

* Read before the American Surgical Association, June 2, 1923.

relatively extended when compared with the others. The palm is hollowed from side to side as well as in its length.

If the hand is to be rendered passive by a splint, this splint must fulfil the following conditions: It must maintain the hand in the physiological position of rest, preserve the normal arches of the hand and allow suitable motion.

The Arches of the Hand.—The hand is made up of three main arches, one longitudinal and two transverse. The longitudinal arch has as its bony arch the moderate palmar curve of the metacarpals and the slight curve of the carpus. The arch is accentuated by the disposition of the fascia in the hollow of the hand and by the fact that in the position of rest the fingers are slightly flexed.

Of the two transverse arches the proximal or wrist arch is a deep, trough-like structure formed by the carpal bones. This trough carries the flexor tendons, its roof is formed by the annular ligament, its radial wall by the trapezium and the semilunar, the ulnar wall by the ulnar and pisiform. The tendons of the long muscles which flex the fingers use the hook of the ulnar as the ulnar fulcrum and the trapezium as the radial fulcrum, the greatest force coming against the trapezium. Any relaxation or flattening of the arch weakens these lateral fulcrums and force the tendons to work at a great mechanical disadvantage.

The distal transverse arch has a gentle palmar curve and is formed by the heads of the metacarpals. It is a broader arch than the carpal and is increased



FIG. 1B.—X-ray showing atrophy of destruction.

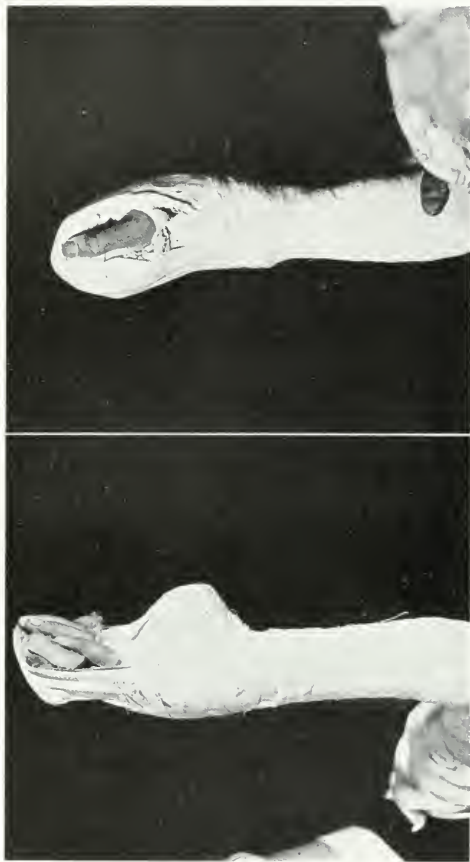


FIG. 1C.—Shows the first stage in the treatment of stiffness and deformity of the wrist. The placing of hand and wrist in the position of rest. Later to be followed by wedging according to the Dickson technic, etc., for the deformity of the fingers.

in depth when the hand is used, due to the flexibility palmward of the fourth and fifth metacarpals.

The arches of the hand are not to be considered as mere bony frameworks, but as living, functioning, structures composed of bones, joints and ligaments, the functional integrity of the whole depending on a healthy musculature. The intrinsic muscles of the hand play a most important part in maintaining this integrity. In extension the fingers spread out like a fan, in flexion they converge toward the palm, the middle finger alone flexing in the line of its metacarpals. The tip of the thumb comes in contact with the other fingers, but faces in an opposite direction. This coordinate converging movement is absolutely essential to the delicate use of the hand and is impossible unless the carpal arch is preserved. In ex-



FIG. 1D.—Ten months later. The result of treatment a strong powerful grasp.

amining cases of paralysis of the interossei from nerve injury the movements of adduction and abduction of the fingers during flexion and extension have frequently been mistaken for true interosseous movements. The extrinsic extensors can splay the fingers, the long flexors converge them, but no muscle group other than the interossei can move the middle finger from side to side in the plane of the extended hand.

The Thumb and Its Relation to the Hand.—The thumb is the most important digit of the hand, its functional value exceeding that of the four other fingers. The capsule and synovial cavity of the first carpo-metacarpal joint are distinct from the other carpo-metacarpal articulations, and there is no interosseous ligament binding the thumb metacarpal to the index. The saddle-shaped articular facet of the trapezium allows an unusual freedom of motion. Any muscle which acts upon the joint may produce very unusual movements. This is seen in the "Trick movements of the Thumb" in certain cases of paralysis.

The proper functioning of the thumb is directly dependent on the integrity

of the arches of the hand. Any weakness or damage to these arches means an impairment in strength, mobility and fineness of movement.

From a surgical standpoint we can consider the basal element of the first digit as a phalanx. It possesses many of the functional and developmental characteristics of the phalanges, the most noteworthy function being its freedom of motion. Of all the metacarpals it shows the most varied mobility, next comes the fifth, then the fourth, the index possesses but little mobility, while the middle is the most fixed of all. To procure the best functional results

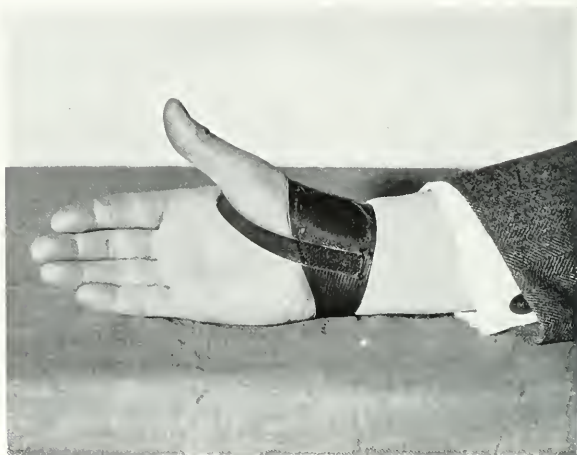


FIG. 2.—Goldwait's flat hand strap.

in atypical amputations and in certain disabilities following trauma these relative mobilities must be borne in mind. Huguier's operation and similar operations are based on the mobility of the first metacarpus; while on the other hand, Baldwin's operation for paralysis of the intrinsic muscle of the thumb, is based on the abolition of this mobility by an arthrodisis of the first carpo-metacarpal joint.

Note that the thumb lies at least in a plane almost at right angles to the other fingers. Its palmar surface faces across the hand with a slight axial rotation toward the palmar surface of the index finger. Try and hold your own thumb in the same plane as the other fingers and see how fatiguing it is, yet we often see a damaged thumb splinted in this unphysiological manner. In fractures of the phalanges the axial rotation must be remembered. Perthes, in his operations for plastic substitution of the thumb, reproduces this axial rotation in the transplanted metacarpal by osteotomy. In the position of grasp

the basal metacarpal of the first digit makes an angle of 60° with the index, this is the functioning position for almost all purposes.

Skin Joints, their Function and Respect Due Them.—The crease lines of the palm and fingers are nicely adjusted stasis planes designed to permit the greatest freedom of flexion to the joints of the hand. Great disability can be inflicted on the fingers and tendons by a thoughtless interference with these planes. To damage existing crease lines is bad enough, to create new stasis lines at right angles to the normal creases may inflict a serious functional handicap. Such a condition is often encountered in the fingers. In the excision of scar tissue, in atypical amputations and in the transplantation of skin flaps precautions should be taken to have the suture line follow as far as possible the normal crease lines.

The Preservation of Tendon Slings and the Gliding Mechanism of the Tendon Sheaths.—The function of the slings is to hold the tendon in place as it passes over the joint. We have mentioned the disabilities which arise from interference with the normal stasis



FIG. 3.—A simple figure-of-eight strap with a palmar pad to support the metacarpal arch, used in cases where the removal or damage of metacarpus has led to a weak and painful hand.

lines, but these are trivial when compared with those that follow the thoughtless slitting up of a tendon sheath. If it is necessary to incise a sheath, the tendon slings should be saved by skipping them.

Treatment.—The physiological treatment of the disabilities of the hand is based on a few simple principles, and these can be applied to disabilities which follow sprains, dislocations, fractures, injuries to tendons, injuries to nerves and to the innumerable lesions which follow in the wake of a cellulitis and trauma.

The outstanding disabilities following these varied pathological conditions are loss of substance, skin contractures, painful stumps, joint stiffness, adherent tendons, bad functional position, drop wrist, flat hand, claw hand, damaged arches, loss of grasping power, ischæmic paralysis.

The functional and anatomical relationships of the structures of the hand

are so intimate that it is rare to have but one structure involved in a disability. As a rule, we have to deal with combinations rather than with individual lesions. The most usual associations encountered is structural damage, adherent tendons and joint stiffness.

In the operative correction it is obvious that deformity and joint stiffness must be overcome before any serious tendon reconstruction can be undertaken.

Treatment of Stiffness and Deformity of the Wrist.—We will take it for granted that the lesions under discussion have received a thorough course of



FIG. 4.—Typical case of flat hand with hyperextended metacarpo-phalangeal joints. This condition is extremely difficult to treat.

physiotherapy and that the disability has failed to respond or that the limit of improvement by these means has been reached. We will omit the treatment of Colles' fracture and the treatment of fracture and dislocation of the carpal bones with the comment that any disability of the hand or wrist (except Colles' fracture in the first stage of treatment) should be placed in the position of rest.

Always try for a mobile wrist, if failure is inevitable or if ankylosis is thought advisable place the wrist at 30° dorsi-flexion. With free pronation and supination this makes a strong, useful wrist. (Figs. 1—A, B, C, D.) When free rotation is impaired by involvement of the inferior radio-ulnar joint it can be restored by the removal of a small portion of the ulna (Cotton's operation).

Treatment of Flat or Weak Hand.—In the simple cases arising from weakness and relaxation, much can be done by suitable muscular exercises. In the cases where there is a yielding of the lateral bony supports of the proximal carpal arch, giving rise to weakness and pain, excellent results are obtained by the use of Goldwait's flat hand strap. The strap to be worn until the muscles

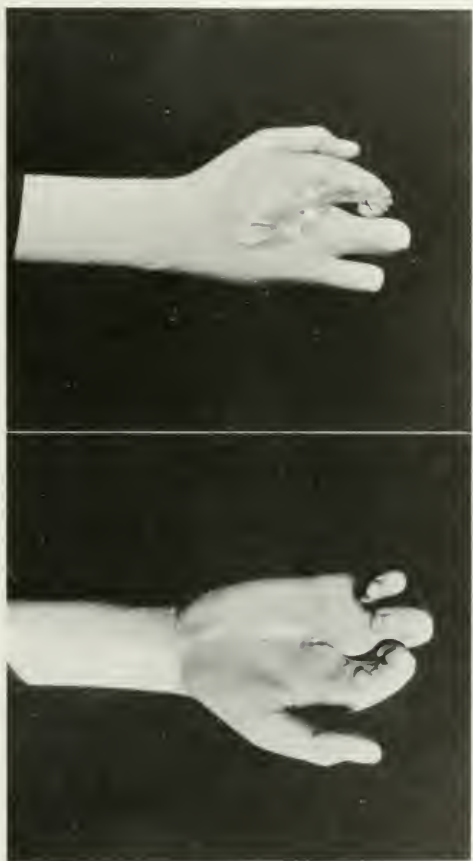


FIG. 5A. A stiff useless clawed right hand, due to damage to the transverse metacarpal arch and partial paralysis of the small muscles of the hand. Condition three months after injury.

and ligaments have regained their tone. (Fig. 2.) In the severe cases, with bony displacement, manipulation under an anæsthetic plus temporary fixation in plaster may be required. In the cases where a weak and painful hand has developed after the removal of a metacarpus, or some portion of it, the author has employed a figure-of-eight strap with a supporting palmar pad or a suitable glove reaching to the fingers, which is reinforced to support the transverse metacarpal arch. Heavy manual work involving the use of this portion of the hand can then be successfully undertaken. (Fig. 3.)

Treatment of Fractures of the Metacarpals.—The most usual deformity is a shortening and dorsal bowing of the shaft, plus a depression of the knuckle.



FIG. 5B.—Anatomical result obtained by Stiles' operation.

The integrity of the longitudinal arch being impaired, limitation of flexion of the metacarpo-phalangeal joints results. Such fractures are best treated by traction with a dorsal pad over the shaft and a supporting palmar pad under the head.

We have seen neglected cases of this type simulate closely the claw-hand that occurs in paralysis of the intrinsic muscles of the hand. The lumbricales and interossei arise from the deep flexor tendons and wind around the proximal phalanx to be inserted into the common dorsal extensor expansion. Their functions are to fix and flex the metacarpo-phalangeal joints and extend the first and second phalangeal joints. It can be readily seen that in fractures with displacement these tiny muscles, in addition to being injured by the fracture, may be placed at an immense mechanical disadvantage. If they are not protected the stronger common extensor will hyperextend the knuckle and the

common flexor will roll up the second and third phalanges. The static condition persisting an adaptive shortening develops which in turn leads to fibrotic clawing of the hand. This condition is extremely resistant to treatment (Fig. 4).

Treatment of Clawing.—The clawing following the paralysis of the small muscles of the hand is a severe disability. If it fails to respond to treatment a useful hand can be obtained by Stiles' operation. (Figs. 5—A, B, C.) In this operation both halves of the sublimis tendon, where it splits to let the profundus pass through, are detached from their insertions and passed to the

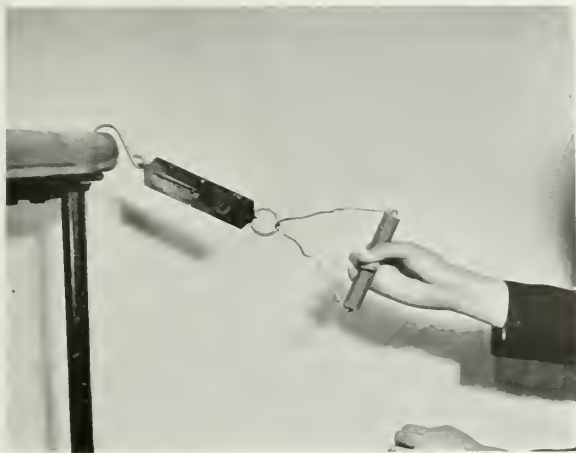


FIG. 5C.—Functional result three months after Stiles' operation. The patient has returned to work. The hand was treated by plastic repair, and traction of the fingers by Baldwin's splint. The maximum improvement having been obtained by these means Stiles' operation was then performed.

back of the finger, to be sutured into the extensor communis tendon distal to the knuckle, thus making an extensor for the interphalangeal joints.

A second method consists in performing an arthrodesis of the metacarpophalangeal joints and placing them in a position of slight flexion.

Thumb.—One of the commonest disabilities of the thumb is the adduction-extension deformity. The most frequent causes of this disability are the skin cicatrices and the fibrous contractures of the deep structures of the first interosseous space that follow burns, trauma and infection; occasionally it is encountered after fractures of the first and second metacarpals; it is the usual sequel to paralysis of the thenar muscles. This deformity is most frequently met with in those cases which have undergone prolonged immobilization in flat board-like splints.

If corrective splinting and physiotherapy fail much can be done by conservative plastic work. In the treatment of paralysis of the thenar muscles we have the choice of two procedures—an arthrodesis of the carpo-metacarpal joint or tendon substitution. An example of the former being Baldwin's operation, of the latter, operations of the type of Steindler's or Ney's.

Baldwin's operation for flat adducted thumb deformity is an arthrodesis at the basal thumb joint to procure a short fibrous union in the functioning position. A short anterior incision is made into the basal joint, the thumb is twisted into the fullest internal rotation, complete abduction and slight flexion,



FIG. 6A.—Baldwin's operation. Flat hand with adducted thumb due to paralysis of the small muscles of the hand. Note the helpless position of the thumb.

e.g., the normal position of grasp for the thumb and forefinger. The articular cartilages are cut from the trapezium and the base of the first metacarpus. "The wound is closed and the thumb fixed in the functioning position for three weeks. Fulllest abduction and internal rotation of the thumb are absolutely essential." The pincer action of the thumb is now made possible and this action is valuable in performing the delicate movements, but unfortunately the grip of the thumb is not restored. (Figs. 6—A, B, C.)

In Steindler's operation for the plastic substitution of the opens action of the thumb the sheath of the flexor longus pollicis is split and the tendon divided longitudinally, one-half of the tendon is inserted into the outer side of the base of the first phalanx and sutured to the periosteum. The sheath of the flexor longus pollicis is then closed. This half of the tendon is now running in the direction of the paralysed opens pollicis, and each flexor movement of the

thumb will be accompanied by an opposition movement of the thumb against the fingers.

Ney's operation is a tendon transplant for paralysis of the intrinsic muscles of the hand. The greatest disability of this condition is the loss of the opposing action of the thumb. To overcome it "The short extensor tendon of the thumb is passed through a tunnel under the anterior annular ligament and transplanted into the tendon of the palmaris longus," or that muscle being



FIG. 6B.—Baldwin's operation of arthrodesis of basal joint has been performed and the thumb placed in the position of grasp.

absent (about 20 per cent. of cases), into the flexor carpi radialis without the division of this latter's tendon.

The Treatment of Stiff Metacarpal Joints.—Under this head we will take up the cases in which there is no gross bony change, but where the flexion of the metacarpal joints have been interfered with by changes in the joint capsule, contracture of the extensor tendons, involvement of these tendons in the scar, or a combination of all three. This latter condition is quite common after infection. Stiffness of the metacarpo-phalangeal joints is always a serious disability because without flexion at the metacarpo-phalangeal joints a good grasp is impossible. The disability is said to be caused by improper splinting. In our experience this is by no means the whole story, we have seen it occur as a sequel in cases of nerve injury and in cases of cellulitis where massage and suitable movements were instituted from the very earliest moment.

From an academic standpoint it is interesting to differentiate between tendon shortening and fibrosis of the joint capsule. From the standpoint of treatment it is immaterial to know which is the predominating element.

Dickson has suggested the following simple test. Pressure is applied to the head of the first phalanx until the metacarpal joint is flexed as far as possible, if active flexion of the interphalangeal joint is possible the limitation is due to



FIG. 6C.—Functional result eight weeks after operation.

a stiff carpo-phalangeal joint. If the interphalangeal joint cannot be passively flexed except when extension of the metacarpal joint takes place, then the condition is one of tendon shortening or tendon involvement.

The treatment of stiff metacarpal joints requires pains, patience, perseverance and time.

The four following methods are used in the treatment of this persistent disability. Manipulation under anæsthetic with fixation of the fingers in flexion; division of the thickened capsule with fixation of the finger in flexion; traction with gradual flexion; gradual correction by means of plaster.

The permanent results from mobilization under anæsthesia are very disappointing. Since the war (1915) we have not employed

this method, except in a few mild cases where the disability was caused by light adhesions. We have no personal experience with the second, and this method does not appeal to us. In the mild cases we have used the traction

and distraction method with success, but in stubborn cases we have obtained our best results by Dickson's method of gradual correction.

In the traction method gradual flexion is carried out while traction is applied to the fingers. The traction is maintained in the line of deformity, until separation of the joint surface is obtained. The direction of the traction is then altered and progressively changed as indicated. During the day traction should be omitted for a few short intervals to permit of massage and exercises. The wrist is fixed in a bi-valve plaster splint in 30° dorsi-flexion. A loop of strong, malleable iron wire surrounds the finger tips and furnishes the bar to which the traction from the fingers is attached. For this purpose Baldwin has constructed an ingenious adjustable finger traction splint.

Treatment by Dickson's method of gradual flexion with plaster. "The metacarpal joints are gradually flexed with plaster; then by means of a retaining splint, this flexion is maintained between massage treatments until there is full voluntary flexion and no tendency to relapse. The ability to flex the joints voluntarily and retain the flexion is the indication for the removal of the splint." The first step consists in the application of a plaster case and the cutting of a window to expose the fingers.



FIG. 7A.—Treatment of stiff metacarpal joints, contracture of extensor tendons, etc., by Dickson method. Condition of hand on admission. The fingers are fixed in the position shown.

A general anaesthetic is preferable but not a necessity. Under anaesthesia, light adhesions are broken up and the maximum flexion of the metacarpals obtained. The hand, forearm, elbow and enough of the upper arm to fix the elbow are suitably padded with cotton, excessive padding is to be avoided otherwise the cast will work loose and slip. The hand is placed in the "cock-up" position and the metacarpals flexed as far as possible. The plaster is then applied to include the hand, forearm, elbow and lower third of the upper arm. The thumb is left free. When the cast becomes hard the portion of its palmar surface over the fingers is cut to allow the tips of the fingers to come out. This leaves a plaster cock-up extending half way up the palm. The second step consists in a gradual flexion of the metacarpo-phalangeal joints by wedging with felt pads. The felt pads are wedged between the dorsal beak of the splint and the heads of the first phalanges. The metacarpals being fixed in the cast, the wedging force flexes the metacarpo-phalangeal joints and stretches the contracted structures. This force acting on the heads of the phalanges at right angles to the shaft gives the maximum leverage without any tendency to impaction. The pads are

fixed with plaster to prevent their removal, the patient is instructed to pull his fingers and thus increase the flexion. The pads become quite loose in a few days and additional wedges have to be applied. This procedure is repeated until the metacarpo-phalangeal joints are completely flexed, this takes about four weeks. When the maximum flexion is obtained it is to be retained for a week or ten days. The third step consists in the removal of the plaster beak and the employment of a flexion retaining bar. A notched piece of metal to act as a guide for the traction wire is inserted on the palmar surface of the wrist, and an anchoring metal ring near the elbow. A padded bar is placed over the head of the phalanges, and from the centre of this a wire runs over the guide



FIG. 7B.—Shows palmar aspect of cast cut away and the method of inserting the felt wedges between the beak of the cast and the first phalanges. Complete flexion at the metacarpo-phalangeal joints has been obtained.

post to a traction spring, this spring being in turn fixed to the anchoring ring at the elbow. By adjusting this spring sufficient force can be applied to keep the fingers flexed. It is important to see that the bar rides over the head of the phalanges. The bar is removed during massage, etc. This stage of the treatment occupies ten days to two weeks. The fourth step consists in the removal of the original

cast and the application of a short cock-up splint, the flexion retaining apparatus being attached to a laced cuff above the elbow.

The cuff and traction straps allow free motion at the elbow while the metacarpo-phalangeal joints are kept in full flexion. The apparatus is not to be removed until the patient has obtained the power to flex the joints and retains the flexion. Any tendency to relapse is an indication for further splintage. If it should be necessary to obtain flexion of the interphalangeal joints, traction tapes are attached to the fingers and the retaining bar discarded. These traction tapes should never be used until full flexion of the metacarpo-phalangeal joints are obtained, for if the proximal phalanx is in the extended position the major portion of the force applied will cause impaction. Figures 7—A, B, C, D, E, show the treatment and results obtained by Dickson method.

Treatment of Painful Scars.—If after a reasonable time, no improvement is obtained from physiotherapy, then a thorough excision of all the scar-tissue should be carried out. In addition, one inch of the cutaneous nerve supply should be excised, or the nerve injected with absolute alcohol and the wound closed immediately by suture or by a suitable full thickness pedicle graft.

The Treatment of Painful Finger Stumps. This condition seldom occurs in aseptic cases, if the proper methods of amputation and after treatment are followed. Unfortunately, in the finger stumps resulting from laceration and infection, and despite all care, the patient may be left with an exquisitely tender stump, often the whole finger is involved. The skin, in the earlier cases has a bluish-red, glossy, ill-nourished appearance, in the later stages a certain toughness and lack of pliability. The fact that the amount of disability appears to be entirely out of proportion to the lesion, has led many men to unjustly accuse these sufferers of malingering; the large majority of these cases have a real pathological basis for their pain and tenderness. "He jests at scars that never felt a wound."

The studies carried on during the war have thrown much light on this disturbing condition. Foreign bodies or bacteria were found in almost all cases of fibroneuromata. The study of the cicatricial tissue showed that the nerves, as well as the surrounding structures, were infiltrated with a

dense inflammatory tissue. The nerve filaments and the nerves, instead of following their recognized anatomical paths, were found to follow various structures. They accompanied the newly formed blood-vessels, worked their way into the tendon sheaths or wandered aimlessly about, crossing and recrossing, until they made a veritable network, and all this without apparent rhyme or reason.

Todd has called attention to these findings and concludes that the pain in many of the amputation stumps is due to the generalized inflammatory condition of all the tissues and not of the nerves or nerve endings only. Any operation for relief of pain or tenderness in such finger stumps will not be wholly successful, if a zone of latent infection is entered in the reamputation. With this we heartily agree.

Local operative interference is worse than useless, it stirs up trouble and



FIG. 7C.—Shows padded traction bar over heads of phalanges, the notched metal guide, the traction wire, spring and anchoring ring.

aggravates the condition. If you cannot amputate through healthy tissue it is better surgery to leave these fingers alone until the pain disappears.

Treatment of Mutilations of the Hand.—Partial amputations of the hand are of infinite variety, frequently atypical, and often complicated by contractures and impotent fingers.

We will confine ourselves to a few general principles and take up more in detail the mutilations of the thumb and their plastic repair. In partial amputations of the hand, the object is to try and utilize to the best possible advantage those structures which are intact, or are capable of being made to function



FIG. 7D.—Short splint, elbow free, flexion retaining apparatus attached to a laced cuff above the elbow.

and only to have recourse to a prosthesis when it can aid the remaining functioning structures. Good looks and function often go together, but if necessary good looks must be sacrificed to good function, the only criterion of success in the hand being restoration of function.

As the strength of the palm depends on the integrity of the relationship of the metacarpals, it is essential to preserve the heads in all metacarpophalangeal amputations. The unnecessary sacrifice of such an important keystone is hardly justified by the excuse that soft parts are scanty, as a flap can be readily obtained from the chest or abdomen. To sacrifice it for the sake of improving the symmetry of the hand is a serious error. A primary comparison of the symmetry of such hands will be in favor of the hand in which the head has been excised. If the same comparison is made six to eight months later, it will be noticed that the atrophy of the bone and sur-



FIG. 72. Show the functional results obtained nine months later.





FIG. 8A.—Huguier's operation. Eight years after mutilation of hand by burns, with total destruction of little finger, partial of the index and total of the thumb, with the exception of a small stump of the first metacarpal.



FIG. 8B.—Plastic repair of the contractures by flaps from the abdomen.

rounding parts will have greatly diminished the gap between the fingers and that the symmetry of the hand compares favorably with the unduly narrow hand. The functional comparison is all in favor of the hand in which the head is retained. The excision of the head, besides resulting in a weak hand, often leads to a tender palm which renders the hand useless.

Mutilation of the thumb is a serious functional handicap, not only in itself but also in its effect on the remaining fingers, the destruction of the thumb destroys the most important arm of the prehensile forceps. From a functional standpoint the thumb is more valuable than four fingers. Its loss is rated by the French as a 25 to 35 per cent. disability. The English rate it as a 30 to 40 per cent. disability, considering it the same as the loss of four fingers. The loss of one or more fingers especially the last three, does not diminish to a great extent the functional value of the hand if it leaves the pincer action of the thumb intact.

A great deal of attention has been focussed on the mutilations of the thumb, especially on the loss of the thumb and its metacarpus. The procedures employed to overcome these serious disabilities can be divided into two groups. To the first group belong the two plastic methods of Nicoladoni (1897-98). a. The formation of an opposition finger stump by an autoplasmic pedunculated skin flap which contains a free bone graft. The bone graft gives the necessary rigidity and supplies the point of opposition for the pincer action. b. An autoplasmic transplantation of a finger or toe to replace the thumb.

In contrast to this we have a second group of procedures which instead of employing the transplants from a distance utilize the structures at hand to



FIG. 8C—Huguier's operation. Functional result nine months later. Note grasp.

produce a new thumb. a. To this group belong Huguier's operation (1852) (phalangization or clefting) in which a new thumb is made from the first metacarpus. b. Finger substitution. c. Rotation of the remaining fingers.

In the complete loss of the thumb, Lauenstein (1880) did an osteotomy of the second and fifth metacarpals and rotated the index and little fingers so that their palmar surfaces faced each other. In this manner the hand was hollowed and a certain amount of grasp obtained. d. A combination of the above three



FIG. 9A.—Result of Huguier's operation. Formation of a new thumb from stump of first metacarpus. Boy aged nine. Thumb, index, middle and ring fingers blown away by an exploding shell fuse July 20, 1916, Montmacq Oise, France. He sustained a serious compound comminuted fracture of remaining metacarpals, with extensive laceration of soft parts. Treated by Carrel method. Operation July 30, 1916.

scar-tissue and with the amount of available skin. With the hand prone make a dorsal incision midway between first and second metacarpals, the upper extremity corresponding to the middle of the high portion of the interosseous space. This dorsal incision exposes the external border and base of the first interosseous and the dorsal aspect of the metacarpals. Divide the interosseous where it is attached to the bone and reimplant. If present, expose the tendon of the adductor of the thumb, detach it from its insertion on the first phalanx and reimplant. Suture skin edges from before backward. (Figs. 8—A, B, C. 9—A, B. 10—A, B, C, D.)

methods, as performed by Perthes phalangization, finger transplantation and rotation.

Treatment of Mutilations of the Thumb Where the First Metacarpus or a Substantial Portion of it Remains Intact.—Such cases are to be treated by Huguier's operation (phalangization) or by Nicoladoni's second method. A short but useful thumb is obtained by Huguier's operation. This new thumb is made from the metacarpus. Huguier taking advantage of the well-known mobility of the first metacarpus, rendered its inferior half free by enlarging the first interosseous space.

Technic.—The incisions will vary with the

This operation has been modified, in suitable cases, by the excision of the second metacarpus to deepen the cleft and improve the grasp. By this method Perthes produced a useful hand in a girl who had lost all five fingers. He mobilized the first metacarpus, excised the second and third and performed an osteotomy on the fourth and fifth. By excising the second and third metacarpals he obtained a deep cleft which increased the mobility of the first metacarpus. By sectioning the fourth and fifth metacarpals he was able to rotate them so that the palmar surface of this portion of the stump faced the new thumb, thus obtaining a better pincer action for the new hand.

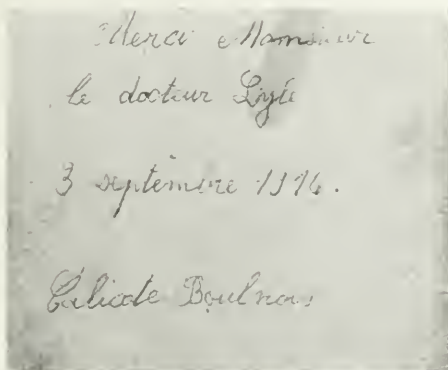


FIG. 9B—Huguer's operation. Functional result September 3, 1916. Note the writing and the grasp of the new thumb.

Nicoladoni of Graz, after having given up his first method, developed his toe transplantation operation in 1898. He made a new thumb by grafting the second toe to the stump of the first metacarpus. The functional result was only fair, the morphological poor. This principle has now been extended and applied to other fingers and toes. In Nicoladoni's original case, as in a number of others now appearing in the literature, the transplantation was done on the base of a movable metacarpus. The functional results are variable and often hampered or spoiled by the adherence of the flexor tendons. Where the mobility of the first metacarpus has been impaired by scar-tissue, etc., this operation yields nothing more than an immobile opposition member. Under these circumstances the functional results are scarcely better than those obtained by Nicoladoni's first method.

Morestin, at the International Surgical Congress, New York, 1914, spoke strongly against this method, considering it next to useless. Some of the results obtained since the war, two of which we have been able to examine, show that the method is of value.

In properly selected cases Huguier's operation yields a better functional result.

Treatment of Mutilations of the Thumb Where Only a Small Portion of the First Metacarpus Remains.—Perthes reports a case in which the thumb,

with the exception of a small stump of metacarpus and the index finger, was destroyed. He divided the second metacarpus 1 cm. above its base and transplanted it into the stump of the first metacarpus. Before securing it in place he rotated the transplanted second metacarpus 90° so that the palmar surface faced the remaining fingers. The result was a strong useful hand. (Figs. 11-A, B.)

Treatment for Total Loss of the Thumb.—Joyce (1917) substituted the ring finger of the opposite hand for the thumb and produced a useful functioning member. Joyce suggests "that by suitable modifications in the details of this operation any lost part of a thumb can be similarly

FIG. 10A.—Huguier's operation. Formation of new thumb from first metacarpus. X-ray of original injury June 6, 1913. Note the damage to the epiphyseal cartilage of the metacarpus.

replaced by substituting for it a part of the finger of the opposite hand."

For the total loss of the thumb, Perthes has developed a procedure which appears to give good functional results. It is a combination of the methods employed in adjacent transplantations. 1. A new cleft is formed between the index metacarpus and the third. 2. The index metacarpus is transplanted to the trapezium to take the place of the thumb. 3. The index finger, as in the Lauenstein method, is rotated so that its palmar surface is in the normal position of grasp and fixed in this position. (Fig. 12.) If this cannot be obtained by modelling the index metacarpus to the saddle-shaped surface of the trapezium, then an osteotomy with 90° rotation must be performed on the transplanted metacarpus. In carrying out this method care should be taken to avoid any unnecessary damage to the intrinsic muscle of the hand. If any tendons of the thumb can be salvaged from the stump these tendons should be secured to the metacarpus or fastened to the appropriate tendons of the new thumb. When the new thumb rotated into the position of grasp the flexor tendons act as abductors of the thumb, and the extensors as adductors.



FIG. 10B.—Condition of hand, showing the formation of a new thumb. July, 1913. Soft tissue has been grafted from abdomen.



FIG. 10C.—Huguier's operation. X-ray of hand nine years later. Note that the metacarpus has developed greatly.



FIG. 1013.—Huguier's operation. Show result after nine years of functional use. This patient has been driving a taxicab in New York for two years.

Treatment of Mutilations of the Hand Where the Thumb Alone Remains.

—The problem is to produce an opposition member. If any metacarpals are present this can be done either by clefting or by transplantation of a toe or a finger, or by a free bone transplant. In a case where the thumb was intact and the four other fingers and metacarpals missing, Albee synthetically grafted a stationary finger by the Italian method. The bone for the necessary rigidity was obtained by free graft from the tibia. This wedge-shaped bone



FIG. 11A, B.—Perthes' operation for mutilation of thumb, where only small portion of first metacarpal remains. Index metacarpal divided 1 cm. above its base and transplanted to stump of first metacarpus, it was rotated 90° and sutured in the position of grasp. A strong useful hand was obtained. (See Perthes.)

graft being driven into a mortise in the os magnum, made a stationary but strong opposing member.

Summary.—"The dense, cold, stiff fingers with smooth bluish-red skin that are left after the storm of infection has passed are poor material for any reconstructive surgery." The lesions we encounter, as a rule, involve several structures and their treatment often calls for different procedures at different stages. When to interfere surgically requires judgment, knowledge and experience.

The maximum nutritional and functional improvement should be obtained by conservative means before embarking on any difficult or extensive reconstructive surgery.

The treatment of many of these cases extends through a long period of time and we must keep in mind Hunter's famous teaching, that the power to heal is the property of living tissue, but the power to recover function—



Fig. 12A, B, C. Shows the result of Perthes operation for total loss of thumb. A new cleft is formed between index metacarpus and the third metacarpus. The index metacarpus is transplanted to trapezium to take the place of the thumb. Note the rotation of the transplanted index. (See Perthes.)

the function of muscles and joints—is the property of the patient's will and brain. It is our duty to direct, encourage and interest the will and brain. Keith has aptly said: "We must not make the mistake of supposing that elaborate batteries, gymnastic machines, etc., can take the place of the thinking brain of the surgeon and the willing response of the disabled patient." In other words, good surgeons, like great artists, must mix their paint with brains.

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GIANT CELL SARCOMA OF THE FEMUR (EPULIS TYPE) WITH METASTASIS IN THE FEMORAL VEIN

By W. G. TURNER, M.D.

OF MONTREAL, CANADA

ORTHOPEDIC SURGEON, ROYAL VICTORIA HOSPITAL

AND

THEO. R. WAUGH, M.D.

DOUGLAS FELLOW IN PATHOLOGY, MCGILL UNIVERSITY

FROM THE PATHOLOGICAL LABORATORIES OF THE ROYAL VICTORIA HOSPITAL AND OF MCGILL UNIVERSITY, MONTREAL
PROFESSOR HORST OERTEL

THE so-called giant-celled sarcomata of the epulis type in bones form an anatomically and clinically well-defined group. Characterized histologically largely by spindle-shaped connective-tissue cells with a variable, but generally quite abundant, number of characteristic multinucleated giant cells, these growths are easily recognized microscopically. Grossly also, their frequent occurrence in the epiphyses of the long bones, the circumscribed, hemorrhagic and occasionally soft, jelly-like and cystic appearances and the local replacement of the bone, are conspicuous features.

The opinion has been growing that these growths are purely local affections and consequently clinically benign. It is shared to-day by a number of competent pathologists and surgeons. Thus Ewing states that he has never known these tumors to yield metastases; Martland writes, "They recur after complete removal, in loco, but I have never seen one metastasize to distant parts," and in fact, he doubts the tumor character; Meyerding omits them from his studies of "Sarcoma of the Long Bones" carried on at the Mayo Clinic because they are considered non-malignant. Similar conclusions are reached by Bloodgood and some others.

Without questioning this general experience and opinion regarding the nature and biological behavior of these growths, the following case is presented as an exception, and more particularly to illustrate the difficulty which confronts the pathologist and the surgeon in the decision as to the nature of neoplastic growths from purely histological evidence. In other words, is it possible to ever state with definite assurance that any growth of so labile and embryonic structure is benign and is the biological position of a tumor always accurately reflected by the histological picture? One must bear in mind that the classification of growths is fundamentally only of didactic value and that precise "pigeon-holing" of these conditions is not supported by natural laws, but remains more or less artificial and academic.

Frank W., a farmer, age forty-one, American, was a strong healthy individual until five months ago. At that time he was working in a quarry and struck his left knee on a piece of stone. This merely made him limp temporarily and he continued work for three weeks. At the end of that time the knee became painful and swollen, movement was limited, and he was forced to give up his employment. He consulted a physician who gave various local treatments and

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finally a six weeks course of X-ray treatment. The knee became gradually more and more swollen and three weeks before admission (approximately seventeen weeks after the injury) the thigh became swollen to the groin and greatest difficulty was experienced in moving the limb both because of its great weight and because of weakness on the part of the patient.

Family History.—The patient has three brothers and one sister alive and well. His father died at the age of sixty-five and his mother died at the age of sixty-three. The cause of death in each case is unknown to him. There is no history of cancer or tumor.

Status Præsens.—Admitted to the Royal Victoria Hospital, orthopædic service of Dr. W. G. Turner, by ambulance May 31, 1922. Temperature, pulse

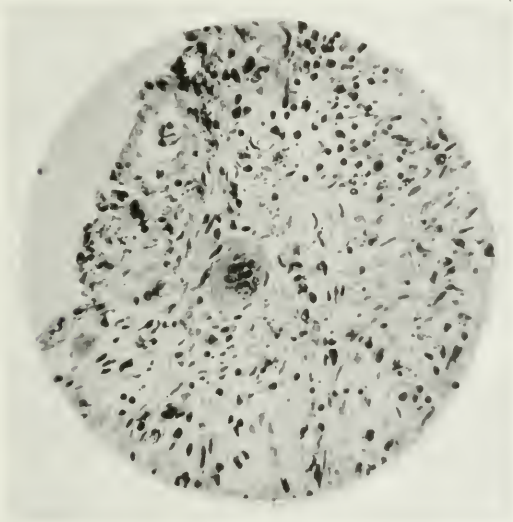


FIG. 1.—A microphotograph of the primary growth in the distal extremity of the femur.

and respirations normal. The patient is a large powerfully built man appearing stated age. Cheerful mood. Obese. Lies in bed with left leg in moderate flexion at the hip and knee and in slight external rotation. This leg is hard, oedematous, does not pit on pressure and measures $5\frac{1}{2}$ inches more in circumference at the thigh and 3 inches more in circumference at the calf than the right leg. It is so swollen and the oedema is so hard that palpation is extremely difficult but there is definitely greater enlargement on the inner side of the lower third of the femur and on the outer side of the popliteal space. The heart and lungs, digestive system, genito-urinary system, and nervous system are negative.

Laboratory Examination.—Blood: Red blood cells, 5,000,000. White blood cells, 8,000. Hæmoglobin, 85 per cent. No abnormal blood picture, Wassermann negative. Urine: Sp. Gr., 1022; acid, clear, no albumen, no sugar, no casts. Dr.

A. H. Pirie, radiologist, submitted the following report: "The X-ray of the knee-joint shows the presence of a malignant tumor arising at the lower end of the femur. It has eroded the femur both in front and behind just above the epiphysis. The tumor has a capsule which casts a shadow suggestive of a little bone or calcification in its periphery. There is also a second large nodule with radiating lines in it going downwards and backwards from the lower end posterior to the main mass of the tumor. The appearance is more suggestive of sarcoma than any other lesion. An X-ray made of the lungs does not show any definite secondary growth."

Clinical Diagnosis.—Sarcoma of the left femur. Thrombosis of the left femoral vein.

Operation.—On June 8th, the left leg was disarticulated at the hip. Notes: Ether well taken. Incision over femoral vessels. Hard oedema and great depth to

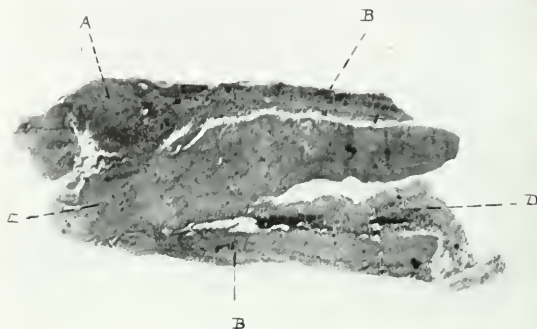


FIG. 2.—Longitudinal section of femoral vein in stump. The section is cut slightly obliquely. A. Tumor growth in vessel wall. B. Venous wall. C. Thrombus. D. Hemorrhagic organizing granulation tissue.

expose vessels. Femoral artery much diminished in volume. Vein completely thrombosed. Both ligated. Circular amputation of upper third and limb removed. Practically no hemorrhage. Disarticulation rapidly done and large flaps partially sutured. Dressing.

The following report (surgical 790/22) was submitted by the pathological department.

Macroscopical Examination.—1. A left leg which has been amputated about the junction of the upper and middle third; it is markedly swollen, oedematous and firm. Over the knee is a roughened area where the skin is thickened and desquamating. 2. Approximately the upper third of the femur including both trochanters, head and part of the shaft, with some tags of muscle and tendon adherent thereto.

After fixation and freezing the leg was split with a band saw and the section shows a tumor growth in the lower end of the femur. This growth is dark red in color, of a gelatinous homogeneous appearance and towards the centre shows cystic softening. It has completely destroyed the bony tissue and projects beyond the bony outline, but as far as can be seen in this gross specimen it is still surrounded by the periosteum and synovial membrane covering the end of the bone.

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The capsule thus formed has been expanded by the increasing tumor mass so as to encroach on the joint cavity, but the cavity itself has not been invaded by the growth. In its longitudinal and transverse diameter it measures 9 by 7 cm.

Microscopic Examination.—Where the tumor is best preserved it is seen to consist of cells which are apparently of connective tissue derivation. For the most part they are elongated or spindle-shaped. Others are more embryonic and are oval or round. Fibril formation is not a marked feature, but rather a tendency to fuse. Many large typical giant cells with centrally placed nuclei are scattered throughout. Towards the periphery of the tumor spicules of bone in various stages of destruction complete the picture.
Diagnosis: Giant-cell Sarcoma (Epulis Type).

Course.—

General condition following operation excellent. Dressings every two days and condition improved steadily. Patient could move in bed easily and had only moderate pain referred to toes. (Edema of the stump however persisted. No pitting. July 8th (one month post-operative): Patient feeling quite well until 11:25 A.M. when, on raising up in bed, he suddenly

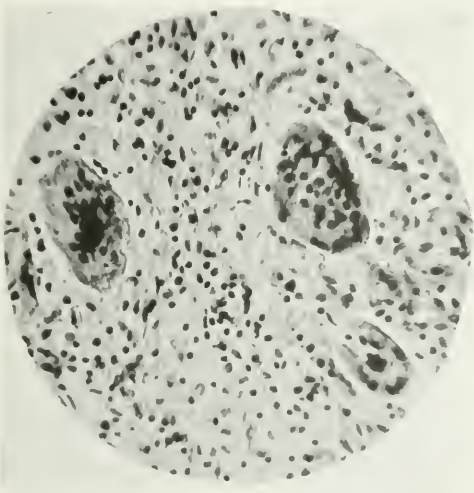


FIG. 3. A photomicrograph of the metastatic growth in the wall of the femoral cyst at the groin.

complained of abdominal pain and rapidly lost consciousness. He died in a few minutes with cyanosis of the face and lips.

Summary protocol of autopsy findings. Section performed eight hours post-mortem by Doctor Grant. The body is that of a very fleshy male, and appears of stated age. Chest and abdomen are well developed. Has had a recent operation of disarticulation of the left leg at the hip-joint. The stump of the leg is much swollen; about five inches more in circumference than the right. At the end of the stump is an open wound 10 cm. long, infiltrated around by a bluish-red granulation tissue, ending in a closed scar 12 cm. long. The stump is closed by an anteriorposterior flap. Above the main incision scar are two longitudinal incisions into the edematous tissue, each about 5 cm. long. The stump is firm and does not pit on pressure. Cyanosis is marked in the face and neck.

On opening the thorax the lungs lie free, collapsed superiorly, but retain their shape inferiorly where they are subcrepitant. The præcordial space is wide and there is a large amount of mediastinal fat. Pleuras free except for slight apical

scarring. Pericardium is free. Section of the lungs shows no evidence of neoplastic involvement.

The right side of the heart is considerably dilated; the left side is contracted and firm. The right auricle contains fluid blood and post-mortem clot. The tricuspid orifice admits three fingers. There is a recent, red, soft thrombus attached to the tricuspid valve. The right ventricle contains post-mortem clot. On opening the pulmonary artery there is found a large yellowish-gray, firm, but friable embolus extending upwards from the pulmonary valves to the bifurcation. The left side of the heart is free. Musculature yellowish but firm. The coronary arteries are free.

On opening the abdomen the parenchymatous organs are found relatively normal. There is general evidence of passive congestion; the spleen is hyper-



FIG. 4.—Longitudinal section of the left leg at the knee, showing the primary growth in the femur.

plastic and the kidneys tend to bulge. On opening the inferior vena cava there is found a large but only very slightly adherent thrombus which extends upward from the bifurcation for a distance of 5 cm. The right common iliac vein below this point is free. The left common iliac vein is free for a short distance (probably separation), but at its bifurcation and extending down the left external iliac there is an old yellowish, pinkish to grayish, firm and adherent, rather fibrinous thrombus. This condition extends down into the amputated femoral region. The aorta shows very slight fatty intimal changes.

Microscopic Examination.—Sections from the embolus in the pulmonary artery present the typical picture of coagulated fibrin, red blood cells, leucocytes, etc. All rather necrotic looking. There is no evidence of neoplastic cells in the embolus. Sections from the thrombus in the inferior vena cava present a similar structure, with no evidence of neoplastic involvement. Sections from the femoral vein in the stump, present, however, a different picture. Within the lumen of the vessel lies a thrombus which at the centre is made up purely of necrotic, poorly staining more or less homogeneous fused fibrin, leucocytes, etc., while peripherally it is in part invaded by granulation tissue with many proliferating fibroblasts,

endothelial buds and some small round cells. One portion of the wall of the vein however has been definitely replaced in this situation by a nodular neoplastic growth, which simulates the original growth in the lower end of the femur except that it is slightly more embryonic (sarcomatous) in character. This growth is thus inserted into and coextensive with the vessel wall. It is composed microscopically of large immature connective tissue cells which show only slight tendency to fibril formation and rather remain in an embryonic spindle-cell stage. Scattered throughout are large giant cells containing many irregularly arranged nuclei (typical epulis giant cells). The growth is vascular and furthermore infiltrated by a large variety of small round cells, lymphocytes, polymorphonuclears, large round cells often with lobated nuclei and transitions into plasma cells and eosinophiles. This infiltration is for the most part diffuse, but in places appears more intense or focal in character. It simulates in some areas myeloid tissue, but special stains do not substantiate this impression.

Sections of the heart show parenchymatous and slight fatty degeneration. The lungs give evidence of a moderate, but rather long standing passive congestion at the base. This condition is also present in the abdominal viscera. There is hyperplasia and pigmentation of the spleen and the prostate is the seat of a glandular hyperplasia.

Anatomical Diagnosis.—Pulmonary embolus; giant cell sarcoma (epulis type) in wall of left femoral vein with secondary thrombosis of femoral and external iliac veins and inferior vena cava; recent amputation of the left leg at the hip for giant cell sarcoma of distal extremity of femur. Passive congestion of lungs and abdominal viscera; parenchymatous degeneration of heart, liver and kidneys; slight fatty degeneration of heart; hypostasis of the lungs; hyperplasia and pigmentation in spleen; glandular hyperplasia of the prostate; fatty infiltration of the liver; obesity.

In retrospect we find an apparently clear-cut course extending over a period of approximately six months. Starting with a very definite history of moderately severe trauma of the lower end of the left femur in a healthy man, aged forty-one years, we have evidence of almost immediate development of a quite rapidly growing neoplastic process at the site of injury. The growth quickly erodes the bone, leaving only the periosteum. Within seven-teen weeks a metastasis has occurred in the wall of the femoral vein leading to thrombosis. Unfortunately the location is high up near Poupart's ligament, so that amputation does not reach it. In the course of six weeks from the first evidence of thrombosis this condition has spread progressively up the iliac vessels and into the inferior vena cava. Slight exertion dislodges a large portion of the thrombus and pulmonary embolization brings about immediate death.

Two questions naturally arise for discussion. First, is the primary tumor a true giant-cell sarcoma of the epulis type? Secondly, is the growth in the femoral vein a metastasis? In answer to the first question, one may say that the tumor certainly presents both macroscopically and microscopically the characteristics of this type of growth and what variations from the usual picture occur may be attributed merely to its more active character, rather than to any real alteration in fundamental nature. Grossly it presents the usual reddish jelly-like replacement of the cancellous portion of the bone, with more rapid than usual absorption of the shaft, so the periosteum alone

remains. Histologically it is likewise typical, as shown by the accompanying microphotograph, and in no way to be confused with a malignant periosteal sarcoma containing fused tumor cells. The clusters of more embryonic, highly undifferentiated cells are but foci of active rapidly proliferating nature. The giant cells are typically abundant, large, diffusely scattered, with relatively clear pink-staining cytoplasm and contain many round or oval, discrete nuclei clumped for the most part centrally.

The growth in the vein, besides carrying an even macroscopically visible, nodular tumor character, and being thus easily distinguished and separated from the thrombus in the lumen of the vessel, presents a strikingly similar histological picture except that it shows even less tendency to fibril formation and a considerable infiltration of small round cells. The distance of this area from the original growth is approximately thirty centimetres and it seems quite improbable that its presence in the groin could be explained by direct extension; moreover the vein below the point of amputation is free from thrombosis and there is no evidence of growth in the tissue in this vicinity. That an embolic fragment from the original tumor entered the blood stream, lodged and took root at this point subsequent to the formation of the thrombus seems likewise untenable from the position of the tumor nodule well within the vessel wall. We must, therefore, come to the conclusion that we are dealing with a genuine metastasis in the wall of the femoral vein, and this is based on the position and tumor-like replacing character of the growth with its quite characteristic histological picture.

CONCLUSIONS

A case is presented of primary giant-cell sarcoma of the epulis type in the distal extremity of the femur with metastasis in the wall of the femoral vein. It shows that this tumor, generally held as local and benign, may metastasize and thus become malignant.

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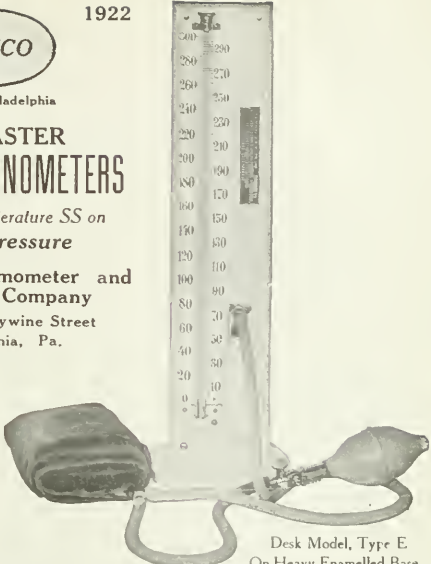
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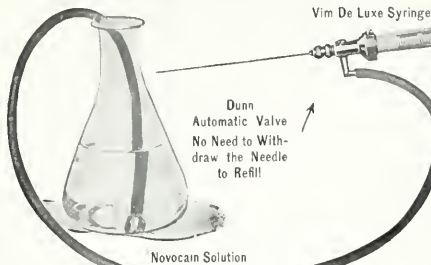
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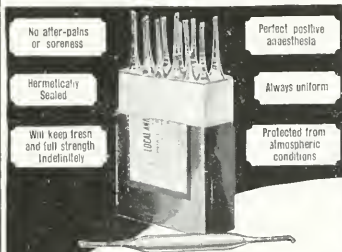
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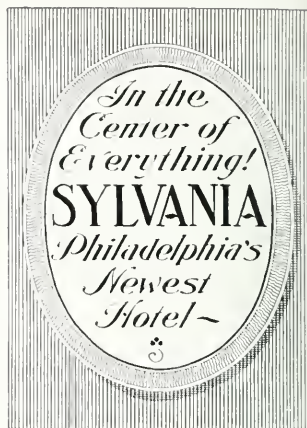
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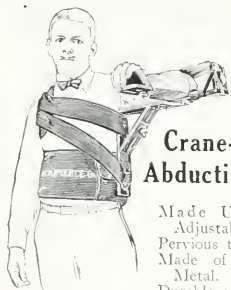
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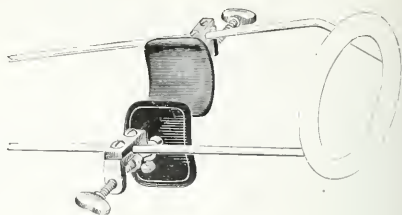


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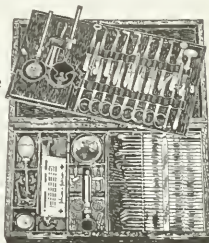
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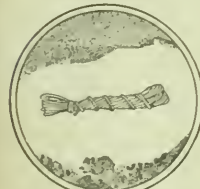
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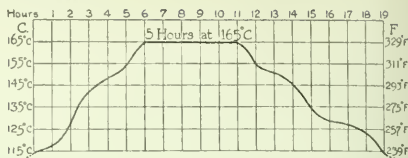
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KALMERID KANGAROO TENDONS are the sutures par excellence for those procedures in which post-operative tension is extreme, or long continued apposition necessary, such as in herniotomy, and in tendon or bone suturing. They are not only sterile, but, in addition, are impregnated with potassium-mercuric-iodide, as in Kalmerid catgut, which enables them to exert a local bactericidal action in the tissues.^{3,4,11}

They are genuine kangaroo tendons; they are smooth, straight, of uniform contour, and possess a tensile strength about twice that of catgut.

The tendons are chromicized, and so accurately is the process regulated that each size will maintain apposition in fascia or in tendon for approximately thirty days.⁸

Kalmerid kangaroo tendons are prepared in two grades—boilable and non-boilable. The latter are extremely pliable.⁷

VARIETIES AND SIZES

Non-Boilable are Product No. 370

The Boilable are Product No. 380

Each Tube Contains One Tendon

Lengths Vary From 12 to 20 Inches

SIZES: 0...2...4...6...8...16...24

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

A wholesale discount of 25% is allowed on one gross or more (\$27 net per gross); carriage paid

THE PERMEATION OF KALMERID SUTURES BY POTASSIUM-MERCURIC-IODIDE



The lighter shaded specimen is a cross section of a strand of plain Kalmerid catgut, highly magnified.

The darker shaded specimen is a cross section of the same strand reacted upon by ammonium sulphid to precipitate the mercuric element.

The uniform color throughout the darker section shows the thorough permeation by the potassium-mercuric-iodide, the equable distribution of which assures a supply of this germicidal substance in the tissues until the suture is entirely absorbed.

General Qualities of All D & G Sutures

THE SALIENT FEATURES of all varieties of D & G Sutures are compatibility with the tissues, perfect absorbability, maximum tensile strength,

accuracy of sizes, flexibility, and absolute sterility. They are unaffected by age or light, or by extremes of climatic temperatures.

Various Non-Absorbable Sutures

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
350..Celluloid-Linen Thread...60 Inches.....000, 00, 0		
360..Horsehair.....4 28-In. Sutures.....00		
390..Plain Silkworm Gut.4 14-In. Sutures.....00, 0, 1		
400..Black Silkworm Gut.4 14-In. Sutures.....00, 0, 1		
450..White Twisted Silk.....60 In.....000, 00, 0, 1, 2, 3		
460..Black Twisted Silk.....60 In.....000, 0, 2		
480..White Braided Silk.....60 In.....00, 0, 2, 4		
490..Black Braided Silk.....60 In.....00, 1, 4		

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

Wholesale discount of 25% allowed on gross or more; carriage paid

Sutures For Minor Surgery

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
802..Plain Catgut, Kalmerid...20 In.....00, 0, 1, 2, 3		
812..10-Day Catgut, Kalmerid.20 In.....00, 0, 1, 2, 3		
822..20-Day Catgut, Kalmerid.20 In.....00, 0, 1, 2, 3		
862..Horsehair.....2 28-In. Sutures.....00		
872..Plain Silkworm Gut.2 14-In. Sutures.....0		
882..White Twisted Silk.....20 In.....000, 0, 2		

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$1.50

Wholesale discount of 25% allowed on gross or more; carriage paid

Sutures With Needles

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
904..Plain Catgut, Kalmerid...20 In.....00, 0, 1, 2, 3		
914..10-Day Catgut, Kalmerid.20 In.....00, 0, 1, 2, 3		
924..20-Day Catgut, Kalmerid.20 In.....00, 0, 1, 2, 3		
964..Horsehair.....2 28-In. Sutures.....00		
974..Plain Silkworm Gut.2 14-In. Sutures.....0		
984..White Twisted Silk.....20 In.....000, 0, 2		



EMERGENCY NEEDLE
For Skin, Muscle, or Tendon

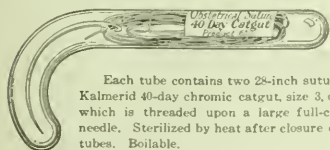
In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

Wholesale discount of 25% allowed on gross or more; carriage paid

Kalmerid Obstetrical Sutures

For Immediate Repair of Perineal Lacerations



Each tube contains two 28-inch sutures of Kalmerid 40-day chronic catgut, size 3, one of which is threaded upon a large full-curved needle. Sterilized by heat after closure of the tubes. Boilable.

One tube in a package

Product No. 650. List Price per tube.....\$.35

Wholesale discount of 25% allowed on gross or more; carriage paid

Kalmerid Circumcision Sutures

Heat Sterilized After Closure of Tubes—Boilable



Each tube contains a 30-inch suture of Kalmerid plain catgut, size 00, threaded upon a small full-curved needle.

In packages of twelve tubes

Product No. 600. List Price per dozen tubes.....\$3

Wholesale discount of 25% allowed on gross or more; carriage paid

Kalmerid Umbilical Tape

Heat Sterilized After Closure of Tubes—Boilable



Each tube contains two 12-inch ligatures of a specially woven flat tape one-eighth inch wide

In packages of twelve tubes

Product No. 892. List Price per dozen tubes...\$1.50

Wholesale discount of 25% allowed on gross or more; carriage paid

Standard Sizes For All Sutures

000	IN conformity with the long
00	recognized need for a
0	unified system of 'sizes, the
1	standard scale of catgut sizes
2	now embraces all sutures, in-
3	cluding silk, horsehair, silk-
4	worm gut, celluloid-linen
6	thread, and kangaroo tendons
8	(only the latter occurring in
16	sizes 6, 8, 16, and 24).
24	

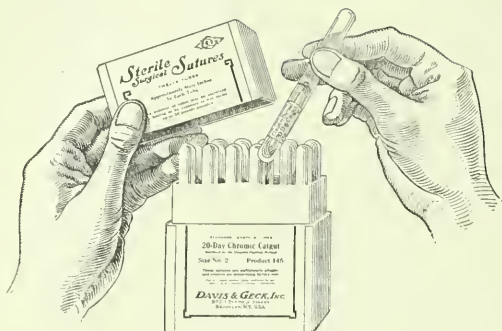
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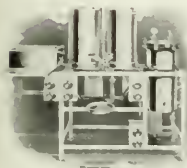
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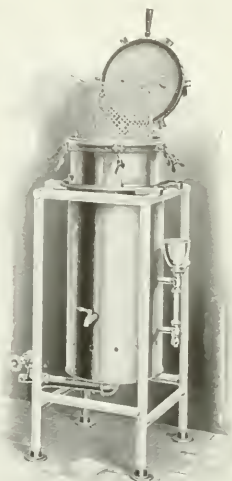
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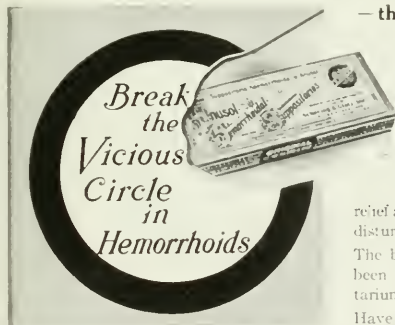


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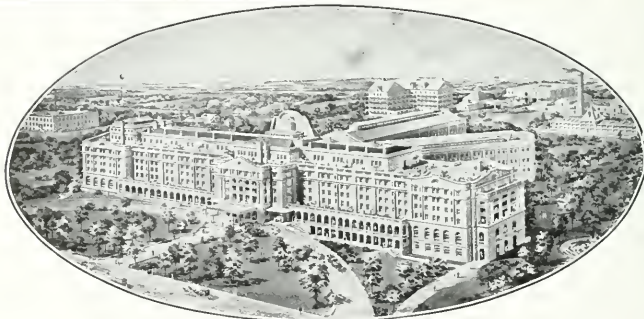
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easier for the physician to inject and less painful to the patient. Even more important, however, is the elimination of unnecessary albuminous substances which in certain patients may cause protein toxemia.

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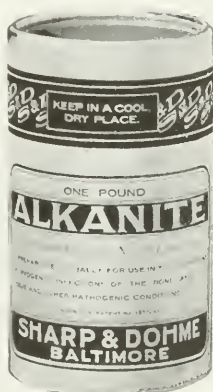




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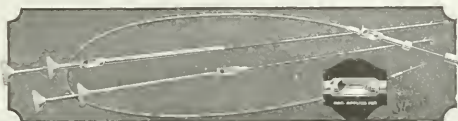
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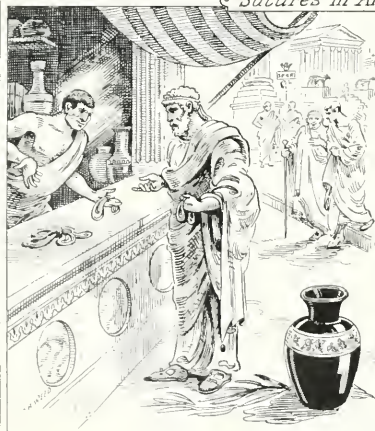
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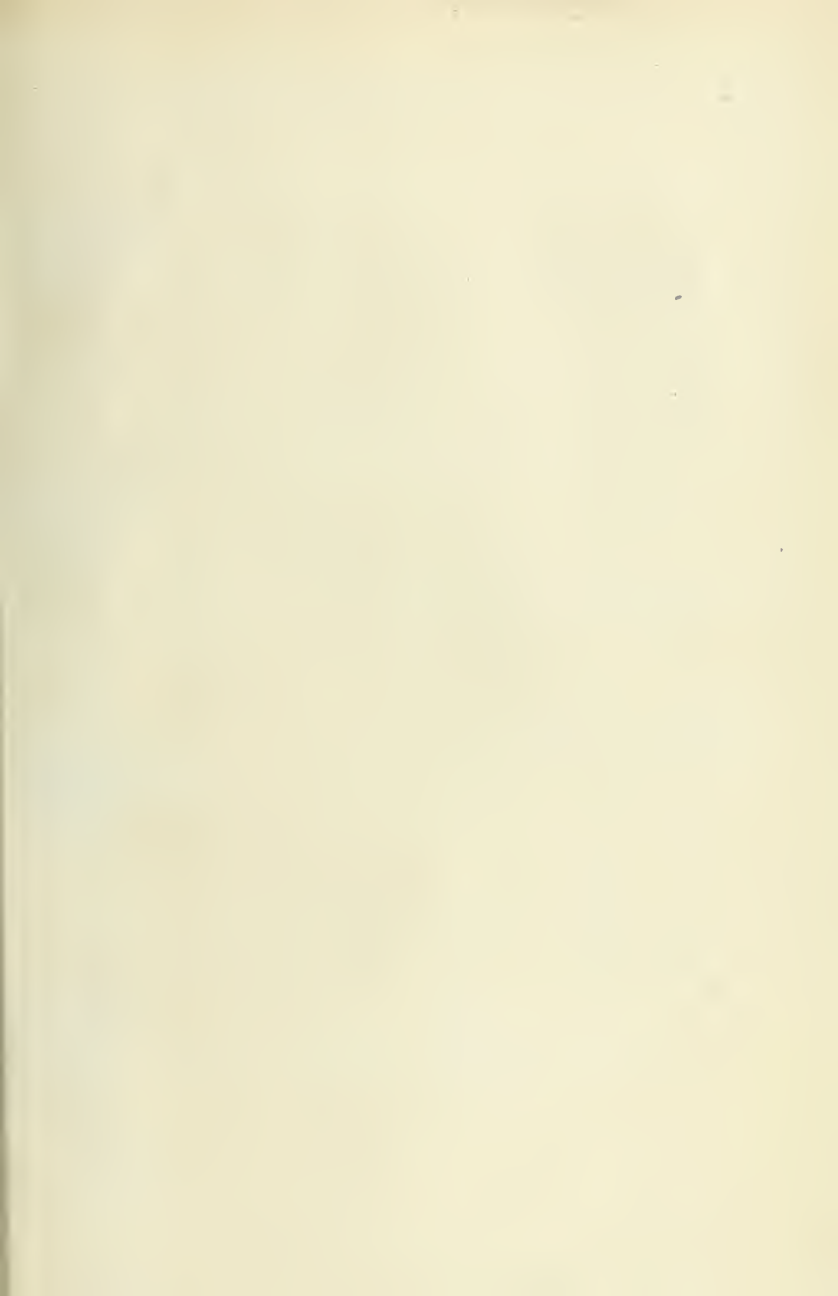
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